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FY72-FY85(U) UNIVERSAL TECHNOLOGY CORP DAYTON OHIO
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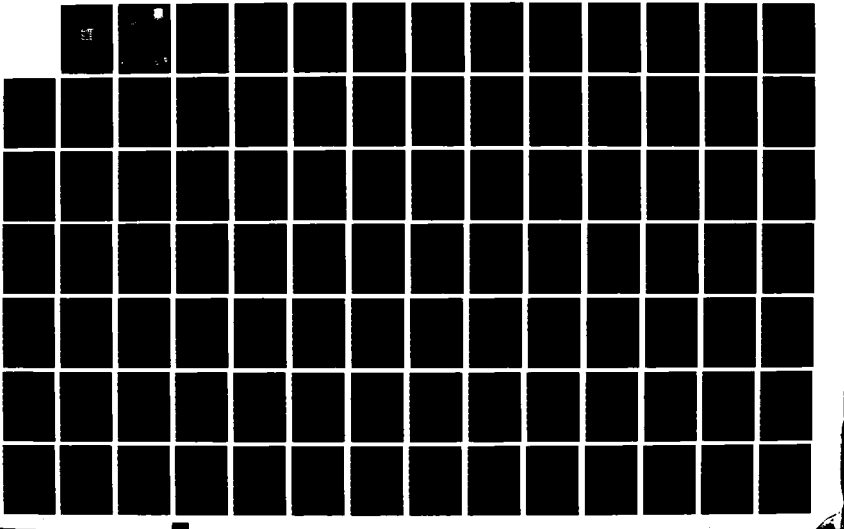

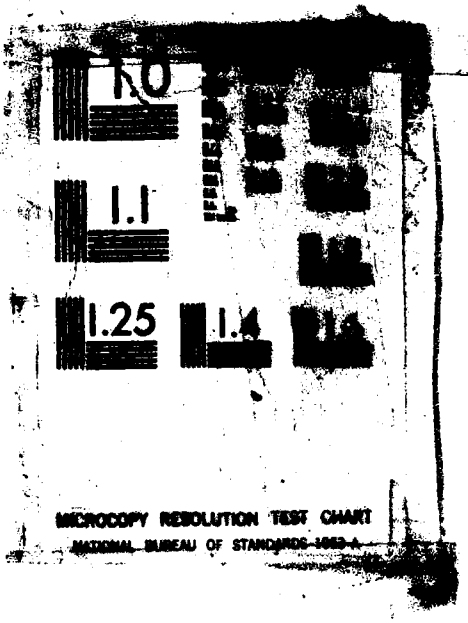
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AIR FORCE MANUFACTURING TECHNOLOGY ELECTRONICS PROGRAM

FY72 - FY85

UNIVERSAL TECHNOLOGY CORPORATION
1270 N. FAIRFIELD ROAD
DAYTON, OHIO 45432

APRIL 1985

Interim Report for Period September 1984 - January 1985

MATERIALS LABORATORY
AIR FORCE WRIGHT AERONAUTICAL LABORATORIES
AIR FORCE SYSTEMS COMMAND
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433

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This report has been reviewed by the Office of Public Affairs (ASD/PA) and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.

John R. Fenter

JOHN R. FENTER, Chief
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FOR THE COMMANDER

William J. Schulz

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Manufacturing Technology Division

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REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION: UNCLASSIFIED	1b. RESTRICTIVE MARKINGS:
2a. SECURITY CLASSIFICATION AUTHORITY:	3. DISTRIBUTION/AVAILABILITY OF REPORT: Approved for public release; Distribution unlimited.
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE:	
4. PERFORMING ORGANIZATION REPORT NUMBER(S):	5. MONITORING ORGANIZATION REPORT NUMBER(S): AFWAL-TR-85-4030
6a. NAME OF PERFORMING ORGANIZATION: UNIVERSAL TECHNOLOGY CORP. / 6b. OFFICE SYMBOL (If applicable):	7a. NAME OF MONITORING ORGANIZATION: MATERIALS LABORATORY (AFWAL/MLTE)
6c. ADDRESS (City, State and ZIP Code): 1270 Fairfield Road, Dayton, Ohio 45432	7b. ADDRESS (City, State and ZIP Code): Air Force Wright Aeronautical Laboratories, Wright-Patterson AFB, Ohio 45433
8a. NAME OF FUNDING/SPONSORING ORGANIZATION: Materials Laboratory / 8b. OFFICE SYMBOL (If applicable): AFWAL/MLTF	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER: F33615-83-C-5077
8c. ADDRESS (City, State and ZIP Code): Air Force Wright Aeronautical Laboratories, Air Force Systems Command, Wright-Patterson AFB, Ohio 45433	10. SOURCE OF FUNDING NOS.

PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT NO.
7.8011F	--	--	--

11. TITLE (Include Security Classification): Air Force Manufacturing Technology Electronics Program

12. PERSONAL AUTHOR(S): General Research Corp.: R. Douglas Hutchens, Urban Hinders, Solion Systems: Michael Stoker, Fran O'Connor

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Yr., Mo., Day)	15. PAGE COUNT
Interim	FROM 840917 TO 850131	April 1985	125

16. SUPPLEMENTARY NOTATION:

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB. GR.	Manufacturing Technology, Electronics, Cost Reduction Conferences
09	03	--	

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

A significant portion of the Air Force Manufacturing Technology Program involves electronics. Many diverse projects have been conducted over the past decade which have made significant contributions to the electronics industry. This report provides the first comprehensive consolidated assessment of the Electronics Manufacturing Technology Program. It summarizes the efforts which have been conducted in the area of electronics manufacturing technology since 1971. It also describes those projects which are currently ongoing as well as descriptions of future activities into the next five years. As a complete document, it can be considered as a baseline report for AF Electronics Manufacturing.

A part of this report is a review of several cost reduction conferences and industrial base studies which have highlighted manufacturing issues. Three major studies have defined manufacturing technology requirements over the past six years. These studies

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT	21. ABSTRACT SECURITY CLASSIFICATION	
UNCLASSIFIED/UNLIMITED ☒ SAME AS RPT. ☐ DTIC USERS ☐	Unclassified	
22a. NAME OF RESPONSIBLE INDIVIDUAL: John R. Fenter	22b. TELEPHONE NUMBER (Include Area Code): 513-255-3812	22c. OFFICE SYMBOL: AFWAL/MLTE

Over

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SECURITY CLASSIFICATION OF THIS PAGE

19. Abstract (cont'd)

include the ESD Cost Reduction Conference (1978), the Air Force/Industry Armament Division Manufacturing Cost Reduction Study (1980), and Blueprint for Tomorrow-Joint Air Force/Industry Assessment of the Aerospace Industrial Base (1983). Common findings of the three studies included the need for improvements in the following areas of electronics: printed wiring boards, assembly/test equipment, cables and harnesses, power supplies, microwave devices, data processing, and hybrids.

The report also describes the major technical areas within the electronics program; there are descriptions of past, present, and future manufacturing technology projects as well as initial R&D opportunities. The technical categories were chosen to closely parallel those of the Tri-Service Manufacturing Technology Advisory Group, specifically the MTAG Electronics Subcommittee. A review immediately leads to the conclusion that the Manufacturing Technology Program has been a leader in advancing the state of manufacturing processing. The range of successes is extraordinary. Varied technologies from printed wiring boards to integrated circuits to microwave devices have received critical assistance in establishing their credibility from this program. Specific examples of these impressive successes include: samarium cobalt magnets, CMOS/SOS integrated circuits, gallium arsenide materials, mini traveling wave tubes, polyimide printed wiring boards, hermetic chip carriers, and the laser pattern generator to name just a few. System implementation has been very broad. It is safe to state that every new Air Force system is implementing electronics manufacturing technology which has been funded by the Materials Laboratory of AFWAL.

FOREWORD

This report was prepared under subcontract by the General Research Corporation. The principal investigator and author was Dr. R. Douglas Hutchens of General Research Corporation. Contributing authors were Urban A. Hinders of General Research Corporation and Michael D. Stoker and Frances A. O'Connor of Solion Systems, Incorporated. Solion Systems performed the necessary computer programming to organize the data base presented in the appendices.

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1.0 INTRODUCTION

A significant portion of the Air Force Manufacturing Technology Program involves electronics. Many diverse projects have been conducted over the past decade which have made significant contributions to the electronics industry. This report provides the first comprehensive consolidated assessment of the Electronics Manufacturing Technology Program. It summarizes the efforts which have been conducted in the area of electronics manufacturing technology since 1971. It also describes those projects which are currently ongoing as well as descriptions of future activities into the next five years. As a complete document, it can be considered as a baseline report for AF Electronics Manufacturing.

The Manufacturing Technology (ManTech) Program is a broad-based, production oriented program supporting the Air Force Research, Development and Weapon System Acquisition Process by providing new and innovative manufacturing technology. Results provide improved, economical, timely and reliable production of Air Force systems. Projects are expected to result in a "factory floor" application of productivity enhancing technologies. Funding of ManTech projects is viewed as "seed money" investment. This Air Force investment is necessary to reduce the technical and fiscal risks of follow-on full production implementation of the technology by the defense industrial base. Competitive selection within the private sector is used to select ManTech project sources. These sources are expected to provide implementation.

The productivity and responsiveness of the defense industrial base is a key element of our national security and military posture. The basic objective of ManTech is to significantly improve the productivity and responsiveness of the industrial base by engaging in initiatives that:

- Aid in insuring the economical production and support of qualitatively superior weapon systems on a timely basis;

- o Insure that advanced manufacturing processes, techniques and equipment are used to reduce Air Force acquisition costs;

- o Continuously advance manufacturing technology to bridge the gap from R&D advances to full scale production;

- o Foster greater use of computer technology in all elements of manufacturing;

- o Assure that more effective industrial innovation is stimulated by reducing the cost and risk of advancing and applying new and improved manufacturing technology.

Section 2 of the report is a review of several cost reduction conferences and industrial base studies which have highlighted manufacturing issues. Three major studies have defined manufacturing technology requirements over the past six years. These studies include the ESD Cost Reduction Conference (1978), the Air Force/Industry Armament Division Manufacturing Cost Reduction Study (1980), and Blueprint for Tomorrow-Joint Air Force/Industry Assessment of the Aerospace Industrial Base (1983). Common findings of the three studies included the need for improvements in the following areas of electronics: printed wiring boards, assembly/test equipment, cables and harnesses, power supplies, microwave devices, data processing, and hybrids. Several of these findings are the subject of numerous programs which are described in detail in Section 3.

Section 3 is a brief description of major technical areas within the electronics program; there are descriptions of past, present, and future manufacturing technology projects as well as initial R&D opportunities. The technical categories were chosen to closely parallel those of the Tri-Service Manufacturing Technology Advisory Group, speci-

fically the MTAG Electronics Subcommittee shown in Figure 1. A review of Section 3 immediately leads to the conclusion that the Manufacturing Technology Program has been a leader in advancing the state of manufacturing processing. The range of successes is extraordinary. Varied technologies from printed wiring boards to integrated circuits to microwave devices have received critical assistance in establishing their credibility from this program. Specific examples of these impressive successes include: samarium cobalt magnets, CMOS/SOS integrated circuits, gallium arsenide materials, mini traveling wave tubes, polyimide printed wiring boards, hermetic chip carriers, and the laser pattern generator to name just a few. System implementation has been very broad[1]. It is safe to state that every new Air Force system is implementing electronics manufacturing technology which has been funded by the Materials Laboratory of AFWAL.

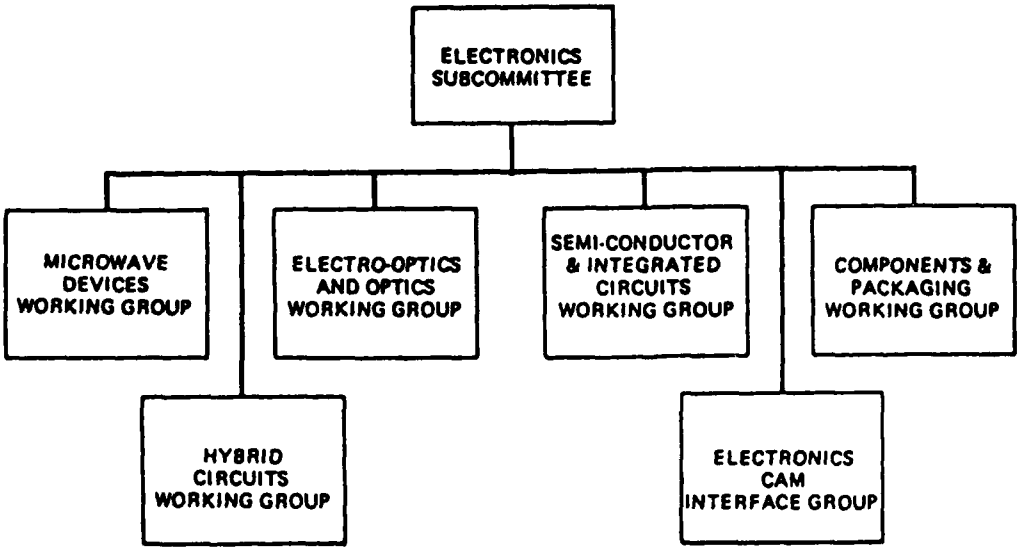


Figure 1. MTAG Electronics Subcommittee

[1]Benefit Tracking Studies for Selected Air Force Electronics Manufacturing Technology Projects, J. J. D'Angelo, Universal Technology Corp., 1985.

Over 100 projects were reviewed for this effort. They include projects funded as early as 1971 to the most recent contract awards. Figure 2 shows the breakout of funding by technical area. As can be seen by the figure, integrated circuits and the microwave device areas are the two categories which have received the most funding.

ManTech projects have been correlated with technology area, mission area, major thrust and the AFSC Product Division supported. This correlation can be found in Appendix A. The mission area and major thrust categories are those identified in the Manufacturing Technology Program.

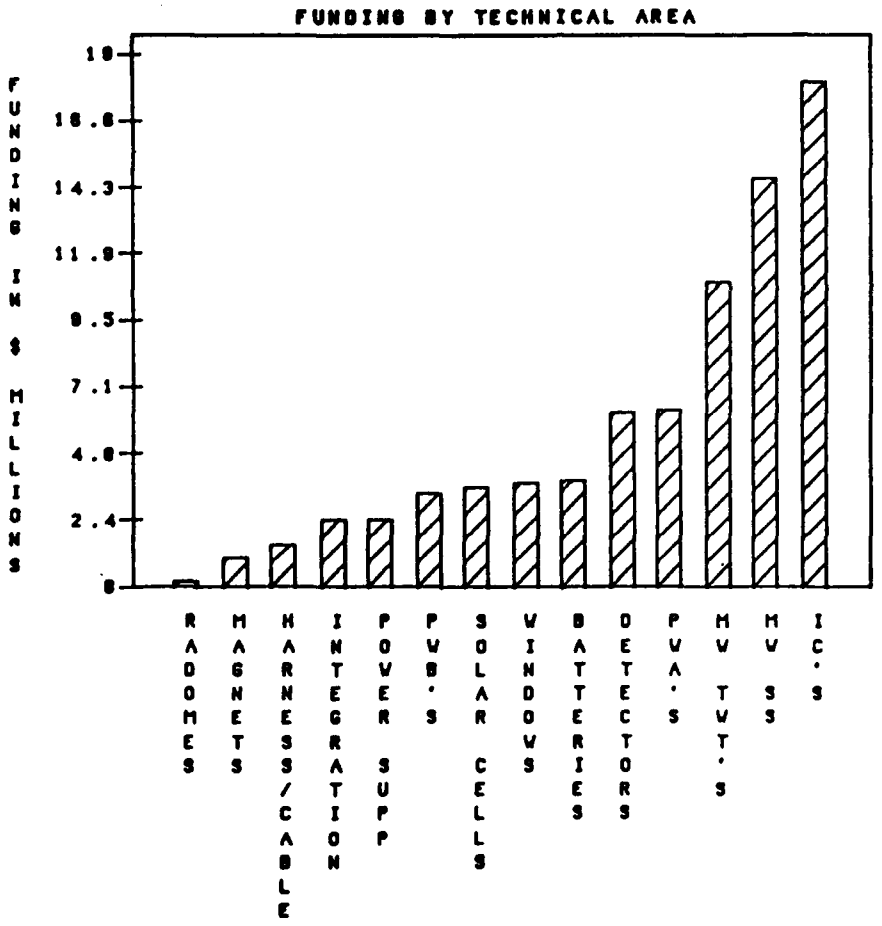


Figure 2. ManTech Electronics Projects 1971 to 1984

The programs were analyzed by the Mission Area supported with the results being depicted in Figure 3. As defined in the Five Year Plan, these Mission Areas are the same which are described in the Air Staff Extended Planning Annex and the AFSC Vanguard Study. The two areas supported the most are C^3I and Tactical Warfare.

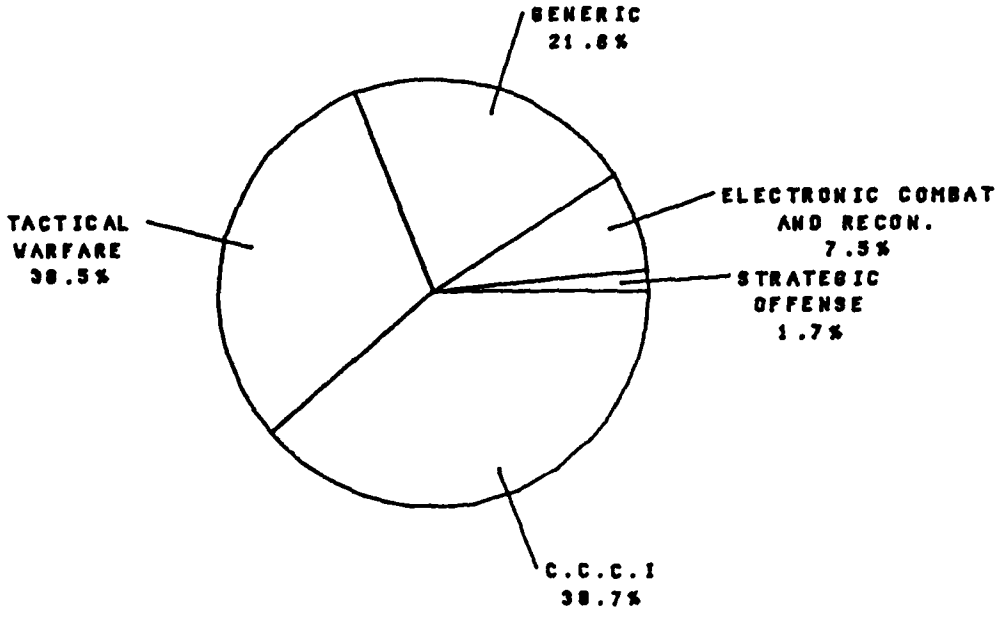


Figure 3. ManTech Electronics Projects 1971 to 1984
Funding Percentage by Mission Area

The C^3I mission objective is to provide U.S. Commanders the capability to plan, direct and control the operations of assigned forces through the application of acquired intelligence. In the area of strategic C^3I, efforts were made to improve the survivability, performance, and coverage of radars and satellites used to warn of an impending airborne missile attack and assess its size and scope. Improvements were also made in the area of tactical C^3I systems. Specific efforts in electronics manufacturing technology for this mission area have been

similar vein the panel endorsed a program to develop and implement automated solder processes. The panel took a forward look at emerging technologies and identified a wide variety of opportunities for application of advanced manufacturing technologies. These areas included higher temperature radomes using spinning and molding in lieu of machining cast billets. Application of composite materials is necessary to reduce missile weight. The application of VLSI/VHSIC to future systems dictates ManTech efforts in this area. Monolithic Microwave ICs to reduce cost, size and weight along with field effect transistors (FET) devices in active arrays make this a high payoff area. Development of hermetic chip carrier compatible PWB's will result in higher reliability at lower cost. There is strong motivation for development of solid state transmitters for increased reliability and reduced cost as compared to tube technology.

Avionics/Electronics (A/E) Subpanel - The subcontractor subpanel members have had little exposure to ManTech projects and in many cases view ManTech as contributing to the "vertical integration" of prime contractors and to an erosion of the subcontractor base. The A/E subpanel strongly urged that ManTech projects to develop competitive technology processes be focused on the subcontractor/vendor community. The A/E Subpanel, as well as the Tactical Missile Panel, cited problems with special test equipment as a critical constraint. Short term solutions include additional equipment and a reduction of test requirements based on test result history. Long term solutions included integrated process control/test, design for testability and development of improved through-put test equipment. The A/E Subpanel echoed the Tactical Missile comments relative to the impact of foreign dependency for materials and components. The Subpanel recommended that the Materials Lab (ManTech) review current pollution prone processing and plating operations and develop alternative low pollution processes. The subpanel endorsed initiatives toward factory automation both on the production line (robotics and artificial intelligence) as well as the computer integration of the total factory process.

assembled. A key feature of Blueprint for Tomorrow was the inclusion of representatives from the subcontractor/supplier element of the aerospace industry as well as the primary systems integrators. The study was structured so that a balanced view of the industry would be provided.

The study participants were divided along functional and product lines. Six working panels were established, representing: Large Aircraft, Fighter/Attack Aircraft, Other Aircraft, Propulsion, Tactical Missiles, and Subcontractors. The Subcontractor Panel was further subdivided into three groups: Structures, Materials, and Avionics-Electronics. Each panel consisted of representatives from industry, the Air Force, and technical support personnel. The panels were headed by chairmen selected from among the industry representatives.

2.3.2 Synopsis of Panel Findings/Recommendations

The majority of the findings/recommendations relevant to the electronics sector baseline are found in the reports prepared by the Tactical Missile Panel and by the Avionics/Electronics Subpanel of the Subcontractor Panel. The comments of these two panels will be discussed separately in the following section. The limited contributions of the other panels will be noted.

Tactical Missile Panel - The panel noted the dependency of the U.S. industry on foreign sources for both material and for components such as semiconductors. Stockpiling was the recommended near term solution together with a long term program to reduce dependency through material substitution and development of U.S. sources (including production of transistors, chips and integrated circuits. Lead time/production problem items were identified as RF devices, ICs, radomes, lens, inertial sensors and power supplies. Manufacturing technology initiatives were recommended for GaAs Impatt Diodes. The panel was concerned over the multiplicity of PWB/solder specifications and suggested a program to review and establish standard solder/solderability specifications. In a

identified complex wave guides (for MMW systems, multimode missile windows, detector arrays and fiber optics) as specific areas for investigation. Panel comments in the data processing problems paralleled those of the Radar Panel.

2.3 BLUEPRINT FOR TOMORROW - JOINT AIR FORCE/INDUSTRY ASSESSMENT OF THE AEROSPACE INDUSTRIAL BASE

2.3.1 Objectives/Scope

The Blueprint for Tomorrow study was conceived to gain insights into the dynamics of the U.S. aerospace industrial base. Through this effort, the Air Force and industry sought to cooperatively establish a common baseline from which to build for the future. Specific objectives were to:

- Develop a better understanding of the current structure and status of the base.
- Identify constraints to more efficient peacetime production of aerospace products.
- Evaluate the ability of the industry to effectively respond to establish goals within specific surge and mobilization scenarios.
- Make specific recommendations to improve peacetime efficiency and ensure that surge and mobilization goals are attainable.

Under the sponsorship of the Aeronautical Systems Division (ASD) of the Air Force Systems Command (AFSC), a team of industry and Air Force personnel were brought together to address the study's objectives. Industry participation was a key factor in the success of the project. A representative cross section of sixty firms which produce aerospace systems and equipment for both military and commercial markets was

of tape chip carriers and leadless chip carriers was encouraged. Other areas of assembly identified for ManTech efforts included automated wire bond pull test, laser welding for hermetic sealing and computerized inspection. The panel endorsed development of test methods and equipment to test and characterize chips at high and low temperatures over the full dynamic range while still in wafer form.

Microwave Integrated Circuits (MIC) technology was another area where manufacturing/fabrication improvement would reduce costs. Increased yields from substrate processing can be achieved through improved mask and etch processes or through development of alternate maskless processes. Special non-destructive test methods should be developed for 100% substrate testing before they are committed to further fabrication testing. Characteristics to be tested include surface finish, dielectric constant, purity and thickness. Automation of MIC assembly is required to reduce costs, increase reliability and assure repeatability. The labor intensive assembly operations must be replaced by automated equipment since the volume produced on manual equipment is not sufficient to support tactical missile production programs.

The panel also identified a number of other areas for ManTech programs. These included programs to address the yield and reliability problems of integrated circuit (IC) manufacture to enable cost effective custom military hybrid microcircuit production. Efforts to reduce the costs of radomes and inertial guidance packages were encouraged.

Optical Guidance and Control - General trends and emerging technologies were evaluated in six areas: sensor data processing, precision parts, interconnects, flight control and high risk items (thin industrial base or foreign dependency). The panel focused on the sensor and data processing areas, recommending that 75 to 80 percent of available ManTech budget be devoted to these areas. In the sensor area the panel

a) To obtain a better understanding of the manufacturing "costdrivers" related to the Air Force Armament product line.

b) To enable more effective allocation of resources available to solve pacing problems in the areas with the greatest possible return-oninvestment, particularly in the Manufacturing Technology area.

Five systems-oriented panels were involved in the study. Each of these five panels, Radar Guidance and Control, Optical Guidance and Control, Airframe, Propulsion and Ordnance, were chaired by an industry member. Each panel conducted extensive cost analyses of their specific armament subsystem. The study was presented 4-6 March 1980 at Atlanta, Georgia.

2.2.2 Synopsis of Panel Findings/Recommendations

The assessment of major armament system cost drivers showed that the major costs (60-75%) of armament systems are associated with the guidance and control sections with the remainder distributed between airframe, propulsion and warhead. Only the findings of the Radar Guidance and Control, and the Optical Guidance and Control Panels will be included in this synopsis of panel findings/recommendations. Both panels chose to evaluate emerging technologies and to identify manufacturing technology initiatives to reduce the rising manufacturing costs associated with the emerging technologies. Specific findings/recommendations will be presented for each panel.

Radar Guidance and Control Panel - The panel identified a number of initiatives to reduce the overall cost of producing military hybrid microcircuit devices. Substrate fabrication needs improved process control through on-line monitoring and inspection of printing, masking and conductor testing. Major materials cost reductions are possible through substitution of copper and silver for sub-level conductors. In the assembly of hybrid circuits, additional work in the packaging areas

it recommended continued efforts to improve materials and manufacturing processes for producing PWBs and their assembly in the first level of subsystem fabrication.

Power Supplies - The final generic study finding zeroed in on power supplies, both low and high voltage, as a common point of system failure. Recommended areas for manufacturing technology efforts included design for manufacturability, improved test methods, better material selection and production process controls.

Panel Specific - In addition to the above generic findings there were several panel specific findings. The Special Sensors Panel identified their highest cost driver manufacturing activities in support of signal/data processors and recommended additional efforts be directed toward advanced packaging, automated assembly and test. The Communication, Navigation and Identification Panel emphasized the manufacturing technology for high power/RF devices and the need for processes for the assembly and test of miniature components on small alumina substrates in miocrowave integrated circuit packages. The same panel identified a requirement for advanced manufacturing/test processes for thick film hybrid integrated circuits. The Command and Control Panel identified large scale integrated circuits as an emerging technology and suggested careful investigation of the opportunities for manufacturing technology applications in this area.

2.2 AIR FORCE/INDUSTRY ARMAMENT DIVISION MANUFACTURING COST REDUCTION STUDY (1980)

2.2.1 Objective/Scope

The Armament Division of the Air Force Systems Command in conjunction with the AF Materials Laboratory conducted an assessment of the production/manufacturing costs associated with the acquisition of Air Force-peculiar Armament Systems. The purpose of the study (June 1979-March 1980) was two fold:

Design/Manufacturing Interface - This inability of the designers to be aware of the cost impact of their decisions in the manufacturing arena was evident in almost all system study areas. The long term need was identified for an Integrated Computer Aided Design/Computer Aided Manufacturing (CAD/CAM) capability which would provide an evolutionary "Design for Manufacturing Cost" procedure and data base. The approach should build on manufacturing and design experience.

Wiring, Cabling, Harnessing and Connectors - The complex harness maze was widely cited as a cost driver, with recommendations for better standards, improved materials, manufacturing processes, controls and automated assembly techniques.

Racks, Chassis and Frames - The structural framework of electronics systems was identified as a major cost driver. Since there is a great deal of similarity between the requirements for construction of racks, chassis and frames and other aerospace sheet metal constructions, the suggestion was made that the ICAM demonstration on aircraft sheet metal construction should be closely monitored for electronic construction applications.

Assembly/Test - The study noted attempts to automate in-process and acceptance testing of electronic devices, components and subsystems and recommended further efforts. It was suggested that recent advances in the areas of robotics and "intelligent/sensory" manipulation manufacturing systems could be applied effectively to the assembly/test of electronic items. As a minimum there should be a close integration between automated assembly operations and automated tests to avoid building in blockages of effective testing.

Printed Wiring Boards - Lack of reliable, reproducible sources of PWBs was identified as a wide-spread plague on ESD systems acquisitions. Although the study recognized advances in materials and market awareness

the Panels conducted a detailed cost analysis of specific electronic systems and component acquisition.

The Study culminated in a Conference in Hyannis, Massachusetts on 22-25 October 1978. The compiled data base was presented and discussed at this meeting, with Panel recommendations offered for consideration by the Air Force.

2.1.2 Synopsis of Panel Findings/Recommendations

The study findings relating to Manufacturing Technology were broken down into two categories; generic and panel specific. Generic findings were prescribed by three or more panels and are considered common to the industry as a whole. Panel specific fundings may also have wider applications. The generic study findings are shown in Table 1; these areas will be touched on briefly in subsequent paragraphs.

TABLE 2.1 MANUFACTURING TECHNOLOGY
RELATED FINDINGS - GENERIC

AREA	NEED
DESIGN/MANUFACTURING INTERFACE	INTEGRATED CAD/CAM CAPABILITY
WIRING, CABLING, HARNESSING & CONNECTORS	IMPROVED PROCESSES
RACKS, CHASSIS, FRAMES	IMPROVED SHEET METAL FABRICATION (ICAM ATTENTION)
ASSEMBLY/TEST	AUTOMATED ASSEMBLY AND TEST
PRINTED WIRING BOARDS	IMPROVED MATERIALS & ASSEMBLY METHODS
POWER SUPPLIES (LV/HV)	DESIGN FOR MANUFACTURING; IMPROVED TEST METHODS

2.0 OVERVIEW OF PAST STUDIES

The current status of Manufacturing Technology available to support the electronics sector has been shaped by a variety of factors. As part of the effort to define the currently existing Electronics Manufacturing Technology Baseline, it will be useful to examine a number of previous studies; to determine the Manufacturing Technology problems/issues identified by those studies; and to correlate previous ManTech initiatives to the problems/issues documented in these previous studies. By this process it should be possible to demonstrate the impact of these earlier studies on the Electronics ManTech Program.

2.1 ESD COST REDUCTION CONFERENCE (1978)

2.1.1 Objectives/Scope

During early calendar year 1978, an Air Force/Industry Study was initiated to review and analyze ground based electronic systems manufacturing costs and recommend manufacturing cost reduction areas for consideration by the Air Force. This study was implemented by the Air Force Electronic Systems Division, in conjunction with the Air Force Materials Laboratory; with industry participating as data base sources and analysts for system production costs. The objectives of the study were:

a) To obtain a better understanding of the manufacturing "cost drivers" specifically related to ground based electronic components and equipment.

b) To identify and apply limited available resources to those areas which will yield maximum benefits toward reducing manufacturing costs.

These study objectives were accomplished through the formation of an Air Force/Industry Steering Committee and five Industry Working Panels. The Panels addressed the areas of Radar, Command and Control, Satellite Communications, CNI Terminals and Special Sensors. Each of

nologies areas as guidance and fusing. Results of this thrust established the availability of critical tactical missile seeker components and basic munitions.

In the Computer Integrated Manufacturing (CIM) thrust the primary activity is the FY85 Integrated Electronics Factory program. The objective of this program is to increase manufacturing, productivity and quality, reduce electronics subsystem costs, improve prime-to-vendor interfaces and generate a closer link between prime aerospace subsystem developers and logistics support. Additional efforts in automated process control, manufacturing information systems and inventory control are being implemented in programs in other thrust areas.

as addressing electronic packaging issues. Fabrication processes for specific chip and package designs have been optimized, controls of fundamental processes such as soldering and plating will be established, and selected fabrication/assembly steps have been integrated and automated to improve quality and reduce cost. This thrust has produced advanced electronics that satisfy the environmental and electrical performance characteristics required by many types of Air Force systems ranging from groundbased to aircraft to space applications. The fundamental aspects of lower cost, higher quality, and producibility are program aspects which have received emphasis.

Specific areas within the thrust include such technologies as microwave phased array radars, traveling wave tubes, printed wiring boards and soldering processes, VLSI/VHSIC implementation, fiber optic components, as well as the generic area of integration and assembly.

The objective of the Space Systems thrust is to establish the manufacturing technology for critical structural and electronic components and assemblies required for space systems needed in communication links, data processing, space surveillance and power. The thrust is broad in scope in order to assure timely availability and producibility of components and devices at an affordable cost. Two primary directions in this thrust are radiation hardened microcircuits including memories and microprocessors and microwave communication for downlinks and crosslinks. Other directions are infrared focal plane array technologies, power sources such as solar cells and batteries, and the structural technology required to provide stable, distortion free platforms for surveillance and tracking systems.

The Tactical Systems thrust has several objectives. The first is the improvement of the producibility of seeker technology components, such as millimeter wave IMPATT diodes, and microwave signal processing devices. The second major objective is the area of basic power systems. Additional effort was initiated in the use of advanced electronic tech-

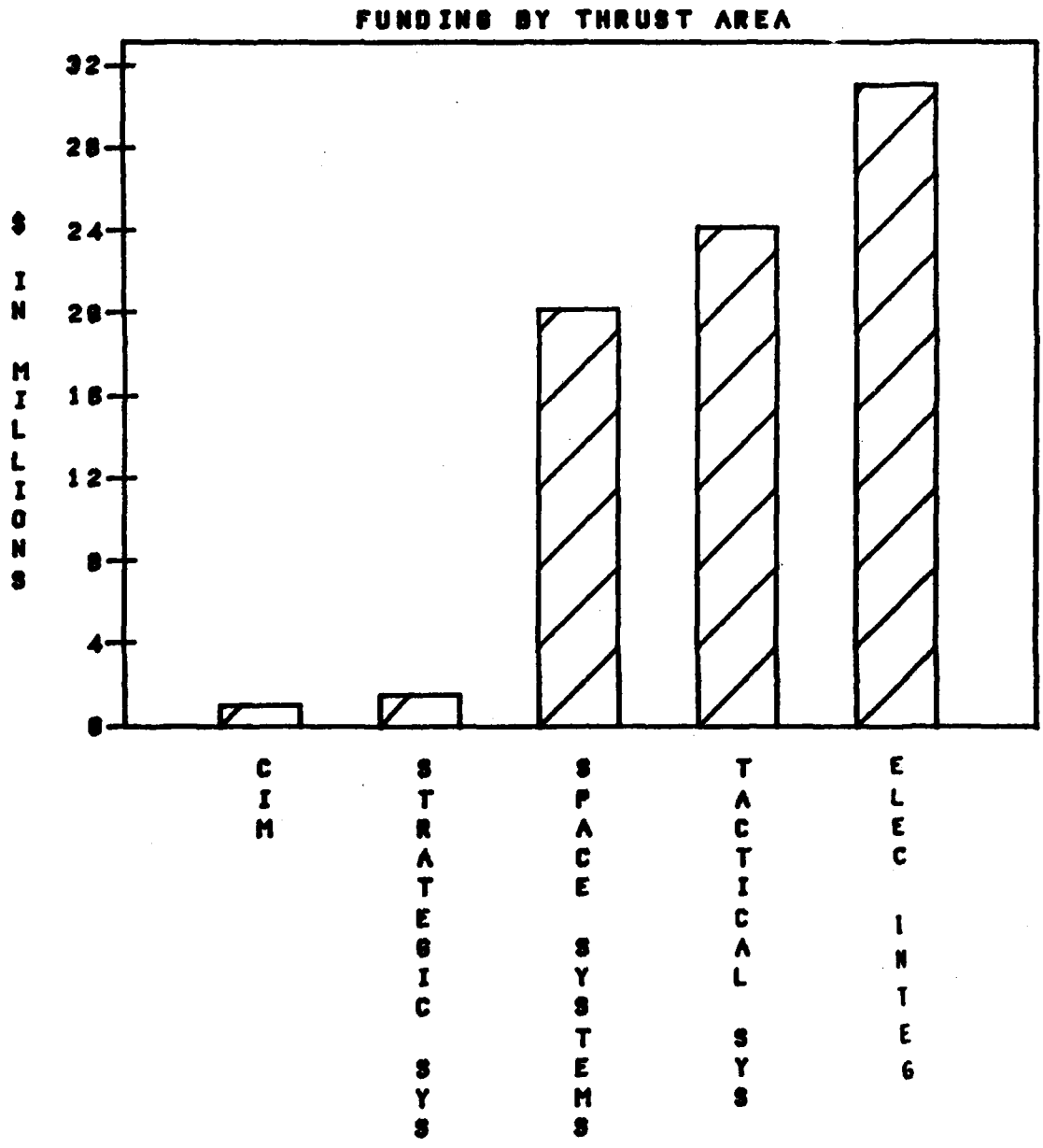


Figure 5. ManTech Electronics Projects 1971 to 1984

MAJOR THRUSTS	MISSION AREAS					
	STRATEGIC OFFENSE	STRATEGIC DEFENSE	COMMAND CONTROL, COMMUNICATIONS & INTELLIGENCE	ELECTRONIC COMBAT, RECONNAISSANCE	TACTICAL WARFARE	MOBILITY
1. AIRFRAME PRODUCTION AND PRODUCTIVITY	S	G			S	S
2. LOW OBSERVABLES STRUCTURES/CONFIGURATION, MANUFACTURING AND PRODUCTION	S				S	S
3. PROPULSION SYSTEMS PRODUCTION AND PRODUCTIVITY	S				S	S
4. ELECTRONICS INTEGRATION AND ASSEMBLY (AIRBORNE AND GROUND BASED)	S	G	S	G	S	G
5. AFLC MAINTENANCE AND REPAIR PRODUCTIVITY (MISSILE AND AIRCRAFT)	S	G	S	S	S	S
6. COMPUTER INTEGRATED MANUFACTURING	S	G	G	G	S	S
7. STRATEGIC MISSILE AND LAUNCH SYSTEMS PRODUCTION	S					
8. SPACE SYSTEMS MANUFACTURING AND PRODUCTION	G	S	S	S	S	
9. TACTICAL SYSTEMS MANUFACTURING AND PRODUCTION					S	
10. MANUFACTURING SCIENCE	G	G	G	G	G	G

G – GENERIC APPLICABILITY S – SPECIFIC APPLICABILITY

Figure 4. Mission Area/Master Thrust Matrix

programs such as radiation hardened integrated circuits and solid state memories, CMOS/SOS technology devices, millimeter wave impatt diode, microwave integrated circuits, and millimeter traveling wave tubes.

The objective of the tactical warfare mission area is the capability by the USAF to assist the Army forces in maintaining or securing territory by defeating the opposing air and ground forces. Programs supporting this mission include: microcomputer fuzes, microwave integrated circuits, solid state transmitters, gallium arsenide impatt diodes, YIG filters, IR detector arrays, ceramic circuit cards, and FLIR components.

Another area which has received a significant amount of support is Electronics Combat, Reconnaissance. This mission area is to adversely affect the enemy's electromagnetic capabilities through electronic warfare (EW), C^3 countermeasures (C^3CM), and suppression of enemy air defense (SEAD) thereby achieving an overall reduction to the U.S. forces attrition rate. Examples of programs in this area are: traveling wave tubes, and infrared detectors.

The AF Manufacturing Technology Program is divided into ten major thrusts which support the major Vanguard Mission Areas. Their interrelationship is shown in Figure 4. The major thrusts supported in the Electronics Program are Electronics Integration and Assembly, Computer Integrated Manufacturing, Strategic Systems, Space Systems, and Tactical Systems. Figure 5 visually depicts the level of past funding support for each of those major thrusts. Electronics Integration, Space Systems, and Tactical Systems have been the three areas most heavily funded in the past.

The objective of the Electronics Integration and Assembly thrust is to establish the manufacturing methods, techniques, process controls, and automation to reproducibly fabricate complex integrated circuits, electronic packages and subassemblies. This thrust should be considered

Other Panel Inputs - The Fighter/Attack panel cited the need for improved reliability in electronics systems and urged ManTech initiatives with emphasis on improved quality and reliability. Both the Large Aircraft Panel and the Other Aircraft Panel identified wire harness fabrication as a cost driver and endorsed ManTech projects in this area. The Large Aircraft Panel also voiced a concern over the lack of awareness/understanding of the ManTech program at critical levels within industry.

2.4 SUMMARY

The three studies reviewed were serious, in-depth efforts to identify cost reduction opportunities and/or opportunities to increase the viability of the U.S. industrial base. The studies were completed and the results reported to the Air Force. These reports made numerous and wide ranging recommendations for ManTech initiatives that would support the study objectives. There are a significant number of ManTech projects either in response to the reports or with direct applicability to the report findings. A tabulation of such projects is included in Appendix B.

3.0 TECHNOLOGY OVERVIEWS

3.1 INTEGRATED CIRCUITS

3.1.1 Past ManTech Efforts

The Manufacturing Technology Program funded one of the first efforts at projection mask processing for integrated circuits with Perkin Elmer (F33615-71-C-1438). This relatively small contract combined with another which was funded in the late 1960s provided the "seed" monies necessary to found an industry. This program resulted in a projection masking system and registration techniques which was capable of replacing the contact masking process. This system is capable of defining small line width patterns with a high degree of uniformity over a large area. The principal advantage of this mask projection system over standard contact printing in IC manufacture is the potential for substantially reduced mask costs and increased production yields. More than 2500 systems, both similar and improved models, are currently used in 125 plants worldwide.

A program with Motorola (F33615-72-C-1242) was instrumental in establishing epitaxial processes for the production of integrated circuit wafers. The result was better yields and thus lower costs. The complete epitaxial process from the pre-inspection of wafers before growth to the final inspection after growth was mechanized. Thirteen interconnected equipment modules composed the manufacturing system. The process was controlled by a CDC 1700 computer. The system is capable of continuous operation with the epitaxial wafers being grown with a plus or minus 5% control on resistivity and thickness.

Programs were funded in the area of surface inspection techniques for LSI. These programs were to provide process controls to minimize process induced damage, contamination, and geometic variations or flows. In the program with Texas Instruments (F33615-73-C-5047), a laser surface analyzes technique was established to provide a quantitative analysis capability for rapid inspection of planar surfaces for gross surface unevenness, scratches, etch pits, haze and other surface irregularities.

The other surface inspection program was with the Canadian Commercial Corporation (F33615-73-C-5175). A complete dynamic voltage contrast digital imaging system was built and demonstrated for both MOS and bipolar devices. An appropriate data recording and display system was constructed. This system can display small differences (100 milliwatts) over relatively large potential ranges (-10 to +10 volts). The system is capable of providing potential maps of the surface of an integrated circuit with a resolution of 100-150 milliwatts, a time resolution of 100 nanoseconds, and a spatial resolution of .5 to 1.0 micrometer. These limits were adequate for most MOS and bipolar devices.

A radiation hardened multiple IC chip package was produced during a program with Fairchild (F33615-72-C-1125). New techniques were applied to existing dielectrically isolated radiation hardened TTL ICs for use in Air Force missile systems. Aluminum leads and bumps were deposited on radiation hardened ICs to eliminate the less reliable and more costly flying lead wires. A multilevel anodized aluminum metallization system was utilized in the fabrication of complex MSI radiation hardened circuits.

A joint project with the Navy was instrumental in making the hermetic chip carrier integrated circuit package a viable entity for military applications. Three programs were funded with Hughes (F33615-77-C-5283), RCA (F33615-77-C-5158), and TI (F33615-78-C-5147). The objective of these programs were to establish the manufacturing processes and techniques required for the production of monolithic devices in a family of ceramic, hermetic chip carrier packages. These packages were capable of meeting military specifications. To meet these specific objectives, the hermetic chip carrier package was optimized with automated processing and testing procedures defined. The family of optimized hermetic chip carrier packages ranged from 16 to 84 input/output pin configurations. Within this family of configurations, military and commercial packaging concepts were consolidated where practical. Phase I included

the definition and optimization of the hermetic chip carrier package in a family of input/output pin configurations. A package specification was written covering all aspects of the hermetic chip carrier including physical property and environmental testing requirements. Production feasibility was demonstrated during Phase I which included assembly and test equipment modification and the fabrication of a limited number of devices of several device technologies.

Phase II consisted of volume production and screening. Devices were manufactured in numbers representative of a typical production run of military qualified devices and cover a range of device types and technologies. These devices were then subjected to full military screening and testing. The results of these programs have been implemented on numerous major weapon systems including AMRAAM, LANTIRN, and B-1B.

A program with Tracor (F33615-80-C-5053) was dedicated to substrate technology efforts for the hermetic chip carriers. Producibility criteria as well as assembly methods were refined for the attachment of HCCs directly on to a suitable packaging and interconnect structure. Parameters investigated included solder alloy composition. flux type, solder attachment techniques, substrate metallization, and HCC metallization. Assembly methods for HCC handling and placement, solder placement and attachment, inspection and repair were thoroughly reviewed and documented.

An effort with Fairchild (F33615-72-C-1522) resulted in the production of compatible MOS-FET and bipolar devices on the same wafer using silicon gate technology. Using a monolithic structure, operational amplifiers and sample and hold circuits were produced to fully demonstrate the MOS-FET and bipolar compatible technologies.

Another program with Fairchild (F33615-72-C-1200) produced techni-

ques necessary for the production of radiation hardened bipolar integrated circuits with MSI/LSI complexity. The MSI/LSI arrays were defined as circuit arrays combining as many circuit functions as previously required in six to twenty separate integrated circuit chips. A number of new manufacturing methods were integrated into a pilot line for radiation hardened circuits. These methods included: multilayer intraconnect, thin film resistors, close dimensional control of dielectric isolation during masking, multilayer masking, and computer aided design.

Funding with RCA resulted in the demonstration of the producibility of silicon on insulating substrate technology. The first effort with RCA (F33615-73-C-5043) demonstrated volume production of high performance MOS arrays using silicon on insulating sapphire. A thin film of epitaxial silicon, about one micron, was deposited on the insulating substrate. The result was the fabrication of low power, high speed thin film arrays. The first devices fabricated were register arrays and floating point scaler arrays. Later during the program complex circuits of read only memories, general processor units and gate universal arrays were produced. The new family of devices were capable of being designed into a microprocessor for radiation hardened applications from air raft to strategic missile to satellites.

A later program with RCA (F33615-76-C-5374) established a manufacturing capability for volume production of radiation hardened CMOS circuits. The program successfully achieved megarad hardened CMOS CD4000 series devices compatible with MIL-STD-38510 specifications. In optimizing the processing three radiation hardened gate insulator processes were evaluated. These include wet oxide, dry oxide and hybrid oxide. The wet oxide yielded the best combination of performance characteristics.

Another program with RCA (F33615-78-C-5135) established a volume production capability for an 8-bit highly reliable CMOS/SOS microprocess

chip set having moderate radiation hardening performance. This chip set includes a full family of RAMS, ROMS, Emulating Controller, 8 x 8 Multiplier, and logic gate arrays in leadless packages to support numerous military applications. This chip set is now commercially available and can be used to emulate almost any minicomputer with existing software. This device family is built to the demanding standards of MIL-STD-883 and has already proved its value in sophisticated military applications. The chip set has been used to emulate the AN-UYK minicomputers and Air Force 1750 instruction set, and has been used in the NAVSTAR Global Positioning System, NASA standard spacecraft computer and other aerospace projects.

An LSI test program was funded with Questron (F33615-78-C-5117). This program provided functional test methods and equipment for radiation hardened CMOS/SOS LSI. Extensive testing for functional verification and validation on various standard parts in the microprocessor family was performed. Parts in this family include the GPU, 8x8 multiplier, ROM, RAM, 2910 controller, emulating controller, and GUAs. This testing uncovered a number of faults which resulted in several parts going through design iterations.

A Westinghouse effort (F33615-78-C-5060) dealt with the techniques required for the economical production of high speed microcircuits which are required in advanced communications and radar processors. Manufacturing controls were defined and implemented to provide quick turnaround design and fabrication of high speed LSI devices. High speed fully functional GUAs were produced as demonstration vehicles.

An effort with TRW (F33615-78-C-5145) fabricated and characterized monolithic A to D converters concentrating on reliability improvements and radiation performance. TRW applied their oxide aligned transistor technology and special A to D converter circuits designs to build A to D converters and related test patterns. These A to D devices were then

subjected to full military characterization and radiation hardness testing.

Manufacturing processes for an optimized operational amplifier (OP-AMP) utilizing the TA-6678 operational amplifier as a technology baseline were generated during a program with Northrop (F33615-78-C-5006). These processes emphasized desired electrical performance in a high transient ionizing radiation environment. Optimization of the OP-AMP encompassed lower power, larger input voltage and the incorporation of diffused resistors for enhanced reliability and yield. This device met all necessary requirements to be utilized in the MX missile.

The various solid state memories have been technologies which have received a significant amount of attention over the past ten years. One of the first programs in the area was one dealing with charge coupled device memory arrays with Fairchild (F33615-74-C-5088). The effort created process controls for the economical volume production of CCD's. The program met the goals of the effort by demonstrating the producibility of a high yield CCD digital memory device containing 16,384 bits of storage. The device was made commercially available as a result of the program.

The manufacturing process evolved during a Rockwell program (F33-615-75-C-5010) for the production of high quality garnet thin magnetic films for use in bubble mass memories. Liquid epitaxy was used to depost magnetic films of the composition Y1.52 Eu0.30 Tm0.30 Ca0.88 Fe4.12 O12 on 1.5 inch and 2.0 inch gadolinium gallium garnet substrates. Ten films were deposited simultaneously, the materials were characterized and the device properties measured. Using the composition mentioned above, good quality films were produced which provide device operation with 4.0 micron bubbles at a 0.5 MHz data rate. As a result of this program device quality films were made available on a commercial basis.

Metal-nitride-oxide semiconductor (MNOS) memory arrays were produced during a program with Westinghouse (F33615-77-C-5149). These types of devices are necessary for a high radiation environment encountered in satellite systems. Processes and controls were documented for the fabrication of 1024 bit MNOS memory arrays in bulk silicon. It was required that the memory electrical parameters such as memory retention and endurance characteristics, read access time and write cycle time should not be degraded by the radiation environment. The 1024 bit MNOS memory arrays successfully achieved a good yield and the desired electrical performance through total gamma dose radiation levels up to 50K rads (Si). 8192 bit MNOS memory array devices were also fabricated but desired device electrical performance goals were not achieved.

A program with RCA (F33615-83-C-5017) also dealt with MNOS nonvolatile memories. This was intended to build on the results of the previous contract to build 8192 bit MNOS memories. Problems have recently been encountered with MNOS memory structures operating in a high energy ion radiation environment. Funding on this program has been reduced and is being directed to better define MNOS memory operational constraints in the above radiation environment.

3.1.2 Ongoing ManTech Efforts

Volume production of specialized gate CMOS RAM circuits is being accomplished during an effort with TRW (F33615-82-C-5111). These circuits are capable of meeting the reliability and radiation requirements of military systems. Processes and design considerations are being verified for application to 16K ROMS and RAMS. Devices are being fabricated and military screening is being performed to MIL-STD-883 requirements. A similar effort on 32K CMOS/SOS ROM circuits is underway at Rockwell (F33615-82-C-5110).

A program with RCA (F33615-81-C-5144) is establishing a capability for the volume production of single chip microcomputers which can oper

ate reliably through the military environment experienced in impact/ delay fuzes for general purpose bombs and tactical munitions. A specification is being written for the single chip microcomputer for the FMU-112/B fuze. Enhanced yield and process refinements will be made and environmental testing done.

A program with Rockwell (F33615-80-C-5127) is specializing in the high yield production of silicon gate CMOS/SOS microprocessor support circuits. Full device characterization and parameter correlation of performance is being accomplished. The devices are being tested to MIL-STD-38510 and military radiation requirements. Four micron processing has been completed with manufacturing design layout, assembly and testing of demonstration devices in progress. Memory Drives, 4K RAM and 8 bit GPU devices have been fabricated on the program and exhibited excellent performance.

3.1.3 Future Efforts

A VHSIC chip screening program is planned for FY-85. This effort is intended to lower the costs of VHSIC chip processing through the use of a repeatable, in-line, quantitative, wafer level screening system. Special emphasis was placed on avoiding non-recoverable training costs of key personnel by establishing readily transferable screening controls that may then be applied to other VHSIC device technologies. It is clearly recognized that this program does not address all the technologies required to produce reliable VHSIC chips. Therefore, emphasis is placed on augmenting an existing operational line with cost saving screening procedures that address military unique requirements that would not normally be pursued by commercial interests. This augmentation will focus on four specific technical areas: 1) standard post process drop-in device test function/structures with wafer level screening procedures; 2) automatic data collection, analysis and front-end operator feedback systems, 3) incoming wafer screening techniques, and 4) water level radiation hardness evaluation techniques.

An enhanced radiation hardened CMOS Microprocessor Chip Set program is being started to produce these circuits on both silicon and sapphire substrates using dual technology design rules. The device types include such circuits as: a 32K ROM (Read Only Memory); 16 Bit GPU (General Processor Unit); DRSU (Double Register Select Unit); MCU (Microprocessor Control Unit); DICU (Double Interrupt Control Unit); BIU (Bus Interface Unit); and MAU (Math Accelerator Unit). This program will provide a parts technology capable of implementing a computer which operates at greater than one million (1,000,000) operations/second for a unit processor.

Another FY85 manufacturing technology program of high potential payoff is Peripheral Circuits for bubble memories. This program will establish producibility of highly reliable bubble memory radiation hardened peripheral electronics that includes sense amp, analog drives and programmable digital controller devices that are capable of operating with both 1 Megabit and 4 Megabit bubble memory devices. Autonomous space systems require the availability of large amounts of on-board memory that can retain data through the occurrence of a nuclear event in space. With bubble memories, a low cost reliable nonvolatible radiation hardened compact memory capable of storing 2 to 3 million words of data can b· nade available.

3.2 OPTICS

3.2.1 Windows

3.2.1.1 Past ManTech Efforts. Efforts centered around zinc sulfide and zinc selenide window and radome technology. These efforts were supported at the Raytheon Company through three different contractual activities (F33615-73-C-5141, F33615-76-C-5256, and F33615-80-C-5013). The first contract dealt with the processes required to produce large zinc selenide laser windows by the chemical vapor deposition technique. Furnace equipment and process parameters were optimized so that large windows up to 34 x 40 x 0.75 inches could be produced while maintaining

excellent optical properties. The material was formed by reacting zinc vapor and hydrogen selenide gas at 750°C in the presence of graphite mandrels. Problems developed in the areas of cracking, foreign inclusions, lack of thickness uniformity, surface absorption and wavefront distortion. Solutions were successfully obtained for each problem during the course of the program.

The second Raytheon program dealt with the establishment of manufacturing processes for the fabrication of spherical domes of zinc sulfide by the utilization of chemical vapor deposition techniques as an alternative to hot pressing. A laboratory CVD process was scaled up such that 114, 7.5 inch domes could be produced in one 52 inch diameter furnace. The resulting production yields were over 70%. The domes had excellent optical quality in the 8-12 micron region for spectral transmittance. The properties of these domes meet or exceed all the requirements of the thermal imaging system of the IIR Maverick system.

The third Raytheon effort dealt with the production of a zinc selenide/zinc sulfide sandwich window appropriate for FLIR system applications. The window size was 14 x 20 x 3/4 inches and consisted of a zinc selenide substrate with a CVD coating of zinc sulfide. The program goal was to produce 16-20 windows per production run. Furnace design was optimized as well as position and type of mandrel and temperature and time of deposition.[1]

A program with Honeywell (F33615-75-C-5042) identified and improved fabrication and assembly techniques used in the manufacture of FLIR's (Forward Looking Infrared Systems). Serially scanned FLIR systems were reviewed in light of new manufacturing processes. These processes reduced acquisition cost and life cycle cost as well as improving performance and reliability. One specific area covered was replacing spherical doublets with aspheric singlet lenses. This was made possible by the use of N/C controlled machines for diamond turning germanium.

Graphite/Epoxy spin mirrors were determined to be a feasible manufacturing technique. The additional areas of long life vacuum dewars, scanner housing vacuum integrity improvements, total evaporated lead attachments to detector arrays and non-destructive testing of detector slabs were also studied during the effort. A follow-on program (F33615-77-C-5130) with Honeywell transferred numerically-controlled (N/C) precision machining of optical components using diamond turning technology from a government facility (Lawrence Livermore Laboratory) to industry. A pilot production facility was established to transfer the technology and test the capability on the production of aspheric optical components.

A non-linear materials design and scale-up effort (F33615-80-C-5009) with Vought established manufacturing techniques for the preparation of non-linear films by an oxidation/reduction process. Uniform deposition was demonstrated on large optical and thermal control substrates.

3.2.1.2 Ongoing AFWAL R&D Effforts. Two radome efforts are ongoing within the Materials Laboratory. The first effort is one concerning ablative broadband radomes. Ablative radomes have several advantages over ceramic designs. These advantages include lower dielectric constants which increase design flexibility and reduce tolerance requirements. The ablative design is also sturdier, resulting in better thermal shock and handling properties. Finally, ablative radomes are lower in cost then ceramic counterparts. Areas which need study are the degree of ablation in relation to electrical performance and the effects of erosion/impact resistance.

An ongoing R&D effort with Raytheon is investigating reinforcing Rayceram with Teflon. Fiber reinforced ceramic radomes have a number of advantages. They have broadband design capability with possible extension to millimeter wave frequencies. They also have better strength, temperature and erosion properties. This R & D effort is a follow-on

effort to a DARPA funded program, thus it is in the very early stage of development.

3.2.1.3 Ongoing ManTech Efforts. No efforts are on-going.

3.2.1.4 Future ManTech Efforts. No efforts are presently planned. The ongoing R&D programs will be assessed after completion to determine potential needs and applications within the tactical missile arena.

3.2.2 Detectors

3.2.2.1 Past ManTech Efforts. Two contracts with Hughes Aircraft Company (F33615-75-C-5283 and F33615-79-C-5142) established a domestic source of intrinsic silicon which is needed for the fabrication of 1.06 micron laser detectors. The first program established the basic manufacturing processes, techniques and controls for the economical production of high resistivity, 15,000 to 30,000 ohm-cm, silicon. The material is produced from high purity polysilicon using a multiple-pass vacuum float zoning process. The second program established the design parameters and specifications required for the zone refining equipment and necessary auxiliary equipment necessary for automatic operation. These programs successfully established Hughes as a domestic source of the intrinsic silicon which is utilized in tactical systems using laser designation.

Efforts have been supported in the area of mercury cadmium telluride since 1978. The initial effort with Honeywell (F33615-78-C-5035) established basic manufacturing processes and techniques for the production of infrared detector arrays. Batch processing techniques were applied as well as automated/computer controlled steps in process evaluation. The second effort with Honeywell (F33615-82-C-5085) and an effort with the Santa Barbara Research Center (F33615-82-C-5077) dealt with the manufacturing processes and test techniques required for the 16 element photoconductive HgCdTe detector array and dewar assembly used by

the IR Maverick missile. Areas studied included polishing, batch etching, automatic thickness measurement, plasma level, cryoprobe test, vapor phase soldering, and automatic wire bonding. The results of these programs have been implemented in the Maverick program and a significant cost reduction has resulted.

Another program with Rockwell dealt with Infrared Focal Plane Array Testing (F33615-79-C-5040). This effort established an automated production test capability of integrated focal plane arrays. These arrays have signal processing electronics on the same chips. Testing is one of the critical deficiencies in meeting focal plane array production requirements. This effort provided a production test system for multiple chips. The system included electrical parameters measurement, data recording, figure of merit computation, statistical data presentation and readout.

3.2.2.2 Ongoing AFWAL R&D and Industry Overviews. In the area of silicon detectors one technology receiving a great deal of attention is Impurity Band Conduction (IBC). This technology has numerous advantages. They include an increased optical cross section due to high doping concentration. The detectors have extended spectral response as well as increased radiation hardness and reduced optical cross-talk. Besides having improved response uniformity there is also reduced response irregularities. Work is proceeding in the evaluation of the development sequence required for Very Long Wave Infrared Focal Plane arrays which are necessary for low background space surveillance.

Mercury Cadmium Telluride efforts are concentrating in the development of Superlattices. By using Superlattices, the potential well structure of the semiconductor can be tailored by the choice of materials and layer thicknesses. This technology will allow for the customization of electronic and optical properties to specific applications, which in turn leads to improved device performance and new device struc-

stablished in a program with Rockwell International (F33615-79-C-5079). ne emphasis of the program was directed at on-line production implementation of control techniques for PWB copper electrodeposition. Included n the study was comprehensive documentation of the technological impact n process yields and product quality. The voltametric stripping for opper pyrophosphate plating was optimized. The program gave printed iring board manufacturers the ability to quantifiably control the copper pyrophosphate, copper acid and tin solder plating baths. The cyclic oltametric stripping analysis equipment was patented and won a 1982 R-100 award. Rockwell has an exclusive license for manufacture and ale of the CVS unit with UPA Technology, Incorporated. This program as resulted in widespread aerospace industry implementation of the CVS echnology[1]

An effort with Westinghouse (F33615-78-C-5151) established production feasibility for automated printed wiring board photoresist exposure. The program demonstrated a dynamic in-line laser pattern generator using raster sensing techniques which was capable of operating irectly from a computer based input. The mechanical, optical, and lectrical properties of the prototype laser pattern generator system arametrics were established as well as appropriate design parameters, control algorithms, and equipment specifications. During the course of he Westinghouse program, there were four significant findings. The irst finding, fundamental to the physics of motion, was that it is ecessary to use the raster technique to generate complex images. The ext was a state of the art development, modulation of a laser beam at everal magahertz. Thirdly, was the demonstration that photoresist xhibit no appreciable reciprocity failure, even when exposed by a high peed scanning laser. This third finding was contrary to the thinking f the technical community. The fourth finding was that raster images ould be generated with sufficient resolution. It is postulated that irect pattern generation by the laser pattern generator may permit the ighest type of resolution over the area the size of a printed circuit

niques necessary for the fabricating, assembly, and test of low cost polyimide boards. Polyimide resin prepreg and laminated characteristics were surveyed. Prepregging parameters such as resin content, resin flow, volatiles, degree of resin advancement, and cure time were studied. This program identified two key process steps in the manufacture of polyimide boards which differ significantly from the epoxy board manufacturing. The first step is lamination conditioning. A higher pressure and temperature is required for successful lamination. Additionally, an extra high temperature post cure (8 hours at 450^{o}) is required. During the program, polyimides received MIL-Specification approval and the number of laminate suppliers doubled. The use of polyimides is increasing at a nominal annual rate of 5-10%. They should receive UL recognition during 1984 which will significantly broaden commercial applications. Military applications now include Trident missile, B-52 Offensive Avionics System, IR Maverick, AMRAAM, Phoenix, TOW, F-15, Cruise Missile, Space Shuttle, F-16, B-1B, PAVE PAWS. This program has been a significant manufacturing technology success story, demonstrating how an industry can be incentivized and the technology transferred to numerous companies and weapon systems.[1]

The objective of a program funded with Martin-Marietta (F33615-80-C-5122) was to improve printed wiring board process yields and simultaneously reduce manufacturing costs by optimizing the PWB design/manufacturing producibility interface. The major emphasis of this program is directed at improving phototooling layout, circuit routing and plated through hole interconnections. An information feedback loop was established to provide the designer with a real time interaction with the manufacturability/producibility of his designs. All systems presently being produced at Martin-Marietta, which have printed wiring boards being designed or redesigned, utilize the results of this program.

Effective, efficient and dynamic process controls for monitoring and controlling electroplating processes for printed wiring boards were

Hughes Aircraft is working on an effort (F04701-82-C-0079) to support DSCS III by addressing several aspects of space TWT manufacturing requirements. Improved processes, controls, documentation, quality assurance techniques are being implemented to increase tube reliability and the manufacturing yield. Automated assembly and test techniques are being addressed, as well as improving manufacturing process for the cathodes and stacking of the magnets.

A cathode program at Semicon (F33615-84-C-5012) is investigating the tungsten-osmium surface for the necessary work function stability. The dispenser cathode is being employed in space TWTs. This effort is intended to make those cathodes a more uniform and consistent electron emitting surface. This will be done by controlling the impregnant granule size and by controlling the distribution with the cathode tungsten matrix.

3.3.2.4 Future Efforts. A FY85 program is planned for traveling wave tube factory integration. This effort will demonstrate improvements to manufacturing technology methods and processes necessary for producing TWTs which will satisfy performance and reliability requirements of advanced ECM and communications systems. The program will investigate improved materials, improved design for reliability and techniques required for ease of assembly and repair. The effort will also involve numerically controlled assembly and process control as well as improved quality assurance and testing procedures. The improved manufacturing techniques and processes will be integrated and demonstrated using a TWT which is required for system implementation.

3.4 PRINTED WIRING BOARDS

3.4.1 Past ManTech Efforts

A program with McDonnell Douglas Electronics Company (F33615-76-C--5045) was instrumental in establishing the viability of polyimide printed wiring boards. This program dealt with the manufacturing tech-

active effort in cathode life testing, particularly B-type and M-type dispenser cathodes. RADC is also investigating new cathode designs such as co-deposited and mixed metal matrix types.

NASA/Lewis has a number of R&D projects underway which support TWTs. This effort is in the areas of multistage depressed collectors reducing both size and weight as well as simplifying the design. They are also investigating the use of graphite in collector manufacturing. Pyrolytic graphite has good strength and machinability characteristics as well as being brazable. In addition, the thermal properties are very good for collector applications. NASA has developed computer simulations of TWTs. The performance output can be modeled with the use of a three dimensional computer simulation program.

3.3.2.3 Ongoing ManTech Efforts. An active contract with Raytheon (F33615-79-C-5148) is establishing the processes required to make I/J Band TWTs available for Air Force ECM systems. Increasing the efficiencies and margin of tolerances are two primary objectives. Pulse and CW tubes were manufactured and then evaluated to determine electrical and mechanical tolerances. Design changes are being implemented to determine performance margins. The tubes will then undergo life testing. This program supports directly the ASPJ ECM system requirements. Another program with Raytheon (F33615-78-C-5150) is dealing with establishing an U.S. source for a high power millimeter wave TWT's which is presently being built by Siemens AG in Munich, Germany. The computer modeling approach as well as the advanced machining and tolerance control for the Siemens tube are being transferred to Raytheon. The first phase is involved in building tubes built with Siemens supplied components. Tubes are then going to be constructed at Raytheon using parts and components produced by Raytheon. This tube is a key component of the MILSTAR system. The tube will be scaled to higher frequency ranges to more fully cover the stated requirements.

parameters and controls critical to the extrusion were studied; areas included extrusion press, billet heater, die, aluminum alloys, and heat treatment. Using a test shape of finned thin-walled waveguide dimensional and geometric quality were related to stretching and handling variables. Control tolerances for cost and wrought 6063 aluminum were extended to 0.0002 inches mean deviations for individual pieces and less than .0005 inches for mean lot deviations. These processes which were established during this program solved a AWACS E-3A production yield problem.

An effort with General Electric (F33615-79-C-5145) improved the manufacturing methods and enhanced the producibility of klystrons. The approach used to improve the klystron production yield was to: correct the manufacturing processes, build-test-verify, implement a liquid cooled distributed load and to test the resulting klystron in the AWACS radar system. The problem of thermally determining the loaded cavities of the tube was resolved. The silicon carbide, previously used to load the cavities was eliminated because of thermal determining effects. The problem was resolved by directly transferring the microwave energy via ceramics to the system coolant. As a result of this program the production yield is now 95% for the AWACS radar tubes. With this improved yield, a $30,000 cost reduction per tube is anticipated. This will result in a projected cost avoidance of almost $15M by 1990.

3.3.2.2. Ongoing AFWAL R&D And Industry Overview. Efforts are underway at the Materials Laboratory in basic cathode research. For space applications cathodes must possess long operating lives. Inhouse efforts are directed at understanding the basic surface effects and interactions present in cathode operation. The Materials Laboratory also has an R & D effort with Lehrer-Pearson to develop improved electron guns. This effort is intended to make electron guns easier to assemble and repair. More dimensionally stable materials, i.e. low coefficient of expansion, are being used in the design. The Rome Air Development Center has an

The effort resulted in an improved circuit design that both increased output power and efficiency. A new collector design both eliminated arcing and microdischarge problems. An improved RF output transition resulted in improved heat transfer and eliminated RF arcing problems. A number of other components were redesigned which resulted in a significant cost savings. The manufacturing advances made on this program made significant impacts on several ECM systems including ALQ-135 and ALQ131.

Another program with Teledyne (F33615-77-C-5068) established the manufacturing techniques required to provide Air Force and Navy ECM with a reduced cost E/H and I/J Band Dual Mode TWT Amplifier. TWTAs were fabricated and tested to demonstrate that the dual mode design is producible at high yield and that the TWT/Power Supply/Modulator interfaces are non-critical. In addition it was shown that the required system performance characteristics can be achieved with a lightweight, low cost, efficient transmitter amplifier module. Electrical, environmental and step stress tests were done on each tube type. The results of these tests were used to determine a specification which has sufficient margin to provide both reliable system performance and a reasonably low cost high yield TWT.

Watkins-Johnson established manufacturing methods for low cost and high reliability fabrication and activation of oxide cathodes for use in space TWTs (F04701-77-C-0048). Existing processes for cathode fabrication and activation, TWT bakeout and TWT aging were evaluated to determine control requirements. Parametric analyses included bakeout rate of change of temperature, dwell time at high temperature, gas pump rate, cathode temperature, and current/voltage levels. Automatic implementation of cathode activation was also established.

A Westinghouse effort (F33615-76-C-5424) investigated improved methods for economical and reliable manufacture of complex thin walled extruded aluminum alloy precision parts for antenna systems. Process

quantities of gallium arsenide discrete and monolithic integrated circuit devices as well as transmit/receive modules for communications, radar, and ECM applications. The program will correlate materials, processes, and techniques to device and module yield, performance and life. The contract will establish and maintain a computerized data base to maintain a technical history of each device resulting from the program. Wafer preparation will be evaluated with respect to type of GaAs, sawing, polishing, and physical and electrical characterization. Demonstration devices will be fabricated which demonstrate low noise amplifiers, power amplifiers, and driver amplifier functions for X-Band T/R modules. The final tasks include wafer characterization, dicing and thinning of wafers, device handling and attachment, fabrication of validation modules, and life testing. This four year program will provide a major impetus to the high volume manufacturing capability of X-Band devices and modules which are necessary for numerous planned applications by 1990.

3.3.2 Traveling Wave Tubes

3.3.2.1 Past ManTech Efforts. Two programs at Varian Associates (F33-615-73-C-5032 and F33615-77-C-5103) were instrumental in establishing a production capability for miniature traveling wave tubes. The tubes were initially built to a power output of 26 watts with a gain of 45 DB and a bandwidth of 5.2 to 10.4 GHz. Electrical and mechanical tolerances were determined for the tubes to minimize tube to tube variations. This tube was implemented into the SLQ-32 Navy system. The resulting production buys resulted in one of the largest TWT purchases ever made. The second Varian program took the basic tube and scaled it to higher power and frequencies for use in an advanced ECM jammer system.

A program with Teledyne (F33615-75-C-5175) simplified the design, and established electrical and mechanical tolerances for a dual mode (CW and pulse) traveling wave tube. Appendages external to the vacuum envelop were both simplified and made assessible for repair or replacement.

source, beamsplitter, detector, and optical elements. The sample is cooled to 2 K in the presence of a superconducting field. This technique will provide qualitative and quantitative optical data to provide guidance in basic crystal growth studies for improved GaAs quality.

Basic material work is underway investigating non-lattice matched, layer structures. The layers are grown by various liquid, vapor and CVD techniques. Another major project involves the purification of Ga, As, and B_2O_3. This program with COMINCO is a joint effort with Canada. The purpose is to develop super purity feed materials for the preparation of improved quality single crystal gallium arsenide wafers. This purity will assist in eliminating problems caused by impurities such as lack of homogeneity, poor electron mobility and thermal instability.

3.3.1.3. Ongoing ManTech Efforts. The ongoing program with Texas Instruments (F33615-82-C-5094) is for high reliability packaging of microwave integrated circuits. This program will investigate methods and processes which are necessary to minimize labor intensive operations and other costs in high volume manufacturing of hybrid MIC's. A systematic integrated cost effective approach to testing, trimming/matching, fabrication, and assembly is being defined, implemented and demonstrated. With the implementation of these processes it will be possible to produce these devices in a cost effective semi-automated environment.

A millimeter wave IMPATT diode program is underway at Hughes Aircraft (F33615-84-C-5022). The intent of this effort is to establish the producibility, uniformity, packaging requirements, and reduce the cost of millimeter wave Impatts. The program will concentrate on diodes in the 60 GHz and 94 GHz frequency ranges for space communications and missile seeker applications respectively.

3.3.1.4 Future Efforts. A planned FY85 program will establish the manufacturing processes and techniques needed to manufacture large

housing materials, as well as attachment media such as solders and epoxies. A crucial part of these investigations involved extended environmental testing of various materials and material combinations, including high-temperature storage, thermal shock, and acceleration. A second important segment of the Phase I effort was concerned with the assessment of automated equipment, particularly those existing systems capable of reducing the high labor component of operations such as substrate and component placement, bonding, and tuning. In Phase II the principal manufacturing processes developed under Phase I were perfected and demonstrated by assembling and testing several broad band FET amplifier stages.

A joint program with the Army at Fort Monmouth resulted in a funded effort at General Electric Neutron Devices Department. The purpose of this project was to expand the production line capability for AT-Cut Crystal Resonators to permit the fabrication and testing of 5.115 MHz fundamental mode SC-Cut Quartz Crystal Resonators. General Electric completed the necessary modifications to the quartz crystal fabrication facility to permit processing of the larger 5 and 10 MHz tactical miniature crystal oscillator ceramic flatpacks. Crystal measurements included angle-of-cut, frequency vs temperature response, and crystalline quality. To assure performance the resonators were stress compensated. Applications include the GPS, JTIDS and SINGGARS systems. Efforts are continuing at Frequency Electronics in the area of device fabrication and at Motorola in the area of basic quartz manufacturing.

3.3.1.2 Ongoing AFWAL R&D And Industry Overview. There is a significant amount of R&D being supported by the Materials Laboratory in the area of materials preparation and microwave packaging. One of the problems is that the purity of GaAs is extremely critical. An inhouse research program is examining the material optically using IR absorption and photoconductivity techniques. A Fourier transform spectrometer system is being built. It consists of a vacuum spectrometer with an IR

nally intended for use in the AMRAAM system; it is now finding utility in several military microwave systems. The diode specification of 22 watts of peak output power was easily achieved. Sixty percent (60%) of the devices actually exceeded 27 watts output with levels above 45 watts seen occasionally. Device reliability was significantly improved with the introduction of new metallization system of Pt-Ti-Pt-Ti-Au. Epitaxial growth of complex p- and n-type GaAs layers were demonstrated with the production of three inch wafers with a thirty percent (30%) yield.

A Hughes Aircraft program (F08635-80-C-0243) mechanized and automated the processing, fabrication, screening, and testing of microwave integrated circuits for AMRAAM. The vehicle chosen was a MIC used on the RF processor and the data link receiver. Both units are produced by Watkins-Johnson who participated with Hughes on the program as a subcontractor. The major tasks of the program included the following: additive circuit delineation using dry laminated photo resist, module modification for producibility, use of thin film capacitors, optimization of thin film assembly, and FET device characterization. As a result of the program, savings in the range of 15-33% will be realized during the manufacture of MIC's for AMRAAM.

Another program dealing with microwave integrated circuits was funded with Raytheon (F08635-80-C-0272). This program was divided into two phases. The objective of Phase I was to establish preferred materials, processes, and equipment for the efficient production of microwave hybrid circuits, or MIC's, in moderate to large volumes. The objective of Phase II was to incorporate the results of Phase I into an unbalanced demonstration pilot line, making refinements and modifications as necessary, and to carry out a limited manufacturing demonstration using the demonstration vehicles selected at the outset of the program. A large part of the effort under Phase I was devoted to the evaluation of materials used in MIC manufacture. These included substrate, carrier, and

voltage overload, and the effects of excessive internal impedances. Ion etching or chemical milling replaced chemical etching to improve precision and reduce the number of required manufacturing operations. Die passivation was used to seal against damage and shorts. Finally, automated assembly and test was implemented to significantly reduce labor costs. This program was extremely successful and assured availability of sufficient quantities of the power transistors to meet PAVE PAWS and BMEWS production requirements. A contract costing $494K resulted in cost avoidance savings of $8.7M for PAVE PAWS and $860K for BMEWS.

Part of the AMRAAM seeker system consists of an impatt diode transmitter. A program with Hughes Aircraft (F08635-80-C-0275) specifically addressed manufacturing processes to improve yield and reduce labor intensive processes. Manufacturing tradeoffs were conducted to maximize producibility. Part of the effort established automated fabrication and assembly methods. Single drift impatt diodes were fabricated under subcontract to M/A-COM using a large bore horizontal vapor phase epitaxial reactor. Diode correlation studies were completed to correlate DC to RF device performance.

A program with Raytheon (F08635-80-C-0288) dealt with GaAs Impatt Diodes. The objective of the project was to establish methods for large volume, low cost production of double-drift pulsed GaAs inpatts. During the contract there was a change in the device construction to improve reliability and to increase device yield. The objectives which were completed in Phase I of the effort were to survey diode package designs and suppliers to define package requirements, finalize specifications for GaAs substrates and for the epitaxial growth, assess chip fabrication techniques, provide D.C. and R.F. testing information, and provide initial epitaxial material. The objectives completed in Phase II were transfer of the epitaxial growth techniques and chip fabrication processes to a production facility, automation of device testing, establishment of a 300/month impatt production rate. This device was origi-

vice is key to the success of the airborne phased array antenna systems, specifically the Electronically Agile Radar (EAR) and the HELRATS system. A program with Microwave Applications Group (F33615-78-C-5186) consisted of a thorough analysis of existing production data to determine standards for the characteristics of the phase control module. Areas of cost reduction were identified and implemented with special attention paid to the phase shifter. The ferrite core was pressed to a near net shape as well as significant improvements which were made in the driver circuit. The unit was reduced in cost from $200 to $134.50 for cost avoidance of $10.4M for the B-1 program. The F-16, and HELRATS programs also benefitted from this effort. Another ferrite program with Raytheon (F33615-78-C-5038) dealt with establishing the relationships between phase shifter performance and the ferrite material characteristics. The standards developed included RF, magnetic, physical, and ceramic properties. Methods for controlling these properties by altering the ferrite material composition were also established.

Methods were established through an effort with Raytheon (F08635-80-C-0175) to enhance the producibility of yttrium-iron-garnet (YIG) filters. These filters are essential to the successful operation of monopulse radars seekers used in such tactical missile systems as the AIM/RIM-7M Sparrow missile. Areas of consideration were the techniques necessary to produce the required permanent magnets, fabrication and finishing of high permeability metals, RF coupling structures, and automated testing and tuning of assembled filters. The results of this program were successfully implemented into the Sparrow production line with significant producibility enhancements.

UHF power transistors are key components for the PAVE PAWS radar system. A program with M/A COM PHI (F33615-83-C-5070) significantly increased the production yield and consequently reduced the unit cost. The effort concentrated on the elimination of deficiencies such as border-line power capability, failure during output mismatch caused by

established a pilot production line. These devices were implemented into both the F-15 and F-18 radars.

The Air Force Manufacturing Technology Program was one of the first organizations to fund the establishment of production processes for gallium arsenide material. Both basic material production as well as substrate production were funded. A program to establish manufacturing processes for high quality gallium arsenide epitaxial layers was awarded to Raytheon Company (F33615-74-C-5031). The program successfully demonstrated the manufacturing processes required to form gallium arsenide layers by chemical vapor deposition. The material produced was suitable for field effect transistors and impatt diodes. Besides demonstrating techniques for depositing the material on large surface areas, techniques were also established for characterizing large quantities of gallium arsenide as well as for handling the finished material and starting materials efficiently. The other program dealing with gallium arsenide was with Laser Diode Laboratories (F33615-75-C-5006). This program dealt with the processes necessary to produce high quality gallium arsenide substrates which are necessary for the fabrication of reproducible microwave devices. The substrates were produced by gradient freeze techniques with the resulting substrates being 50 millimeters in diameter. The substrates were then deposited with a layer of CVD gallium arsenide for evaluation.

GaAs field effect transistors are becoming a standard component of many solid state microwave systems. A program with Raytheon (F08635-80-C-0289) was a significant contributor to establishing GaAs FET manufacturing processes and techniques. The process technology required for one and two inch diameter substrates was established. These devices now are being used in such applications as the ASPJ, Military Landing System, and numerous space satellite systems.

Another area funded was that of ferrite phase shifters. This de-

tures. The R & D efforts will concentrate on growth and uniformity controls, spectral response optimization, performance modeling, and detector demonstrations.

3.2.2.3 Ongoing ManTech Efforts. No programs are on-going.

3.2.2.4 Future ManTech Efforts. It is anticipated that there will be a program to satisfy mercury cadmium telluride and silicon requirements. The program will consist of a number of tasks including material purity, growth and processing, array fabrication and testing. The program is anticipated to start in FY86 and will extend into FY89.

Work will be initiated on mercury-cadium-telluride detectors for use in focal plane arrays in the mid infrared range. Early efforts will concentrate on quality and producibility improvements in the preparation of the basic materials such as CdTe substrates and pure metal processes. Improvements in the producibility of the focal plane arrays using the Vapor Phase Epitaxial techniques will be started. Production processes for long wave length infrared silicon detector material for focal plane arrays will include the preparation of blocked impurity band or boron-free silicon materials and cost avoidance efforts using automated test equipment.

3.3 MICROWAVE

3.3.1 Solid State

3.3.1.1 Past ManTech Efforts. Solid state microwave projects were initiated first in the mid 1970's. One of the initial projects was with Hughes Aircraft (F33615-74-C-5102) to establish economical and reliable manufacturing methods for radar receiver protection. The approach used is a multipactor limiter followed by a pin diode limiter. The multipactor absorbs about 85% of the incident power above a threshold of 8 watts. The pin diode limiter further reduces the power to 50 milliwatts. Hughes determined electrical and mechanical tolerances and then

board. These findings, together with an unique method of optical correction, are necessary for present and future fine-line technology. Both the manufacturers and users continue to benefit from this program. There is a reduction in turn around time from design to production and refinements or corrections, are not only implemented faster but, very often, easier because of the elimination of steps (artwork) in the conventional process. Reduced setup time/costs make even short production runs profitable. The total system lends itself to improve designs and improved printed wiring boards. Two reasons for higher quality are timely feedback to the designers and high quality of the laser/-optical generated patterns.[1]

The fabrication of multilayer thick film ceramic boards with an area larger than 200 square cm using low cost conductors was achieved during a program with Hughes Aircraft (F08635-80-C-0343). Two material systems based on copper metallization, Cermalloy 7116/7029D and Dupont 4575D/9924, were processed to 258 square cm (5 x 8 inch) with six conductor layers with a total board warp of less than 0.6 mm (0.020 inch) and electrical properties equal to or better than gold and platinum-gold systems. Because of superior performance in a high moisture atmosphere the Dupont system is preferred. One result of special significance from this program include the use of thermal processing to control the expansion coefficient of the dielectric materials. Another significant result was the establishment of an electrical design data base for ceramic circuit boards in microstripline, stripline, and unsymmetrial stripline configurations. Implementation has occurred on the AMRAAM program with projected cost avoidance of over $20.0M in precious metals for 20,000 missiles.

The materials and processes for thick copper multilayer technology were identified and successfully demonstrated during a program with Raytheon (F08635-80-C-0169). A significant accomplishment of the program has been the establishment of the necessary material and process

specifications which define the copper MLB Technology. Processing details concerning screening and firing operations, materials and fabrication requirements etc., have been established and documented. Additionally, artwork design guidelines for maximum conductor widths, optimal via sizes, and perforation of Vcc and Gnd planes have also been identified. It was found that, of the conformal coating materials which were evaluated, all were successful at preventing the formation of dendritic growth, and that Parylene-C provided the most protection to ceramic MLBs against moisture penetration. Also, the use of a high-glass density overcoat may provide additional moisture resistance. Humidity test results indicated that susceptibility to moisture penetration is a serious design concern for ceramic MLB technology in general; and that further investigation into MLB moisture permeability is warranted. However, it was noted that the copper-metallized, seven layer "Pipe-B" MLB experienced no degradation in electrical performance after exposure to the ten-day humidity test, and it is felt that this demonstrates a certain degree of functional survivability of copper MLBs to the high moisture environments. Other environmental tests, such as thermal cycling, thermal shock, vibration and mechanical shock, aging, etc., had no adverse effect on the copper MLB test substrates.

Perhaps the most significant technical accomplishment was the successful fabrication, assembly, and testing of the tactical "Pipe-B" module assemblies; which served to verify the real-world applicability of copper MLB technology for the fabrication of a typical high-density multilayer substrates. It is felt that the processes which were developed and utilized for this effort can be directly implemented into the production environment.

3.4.2 Ongoing AFWAL R&D Efforts

R&D efforts are underway at the Materials Laboratory in the areas of printed wiring board resins and laminates as well as basic solder materials. Current PWB materials and solders are not thermo-mechani-

cally compatible with emerging leadless VLSI chip packaging requirements. Specifically, present multilayer PWB materials exhibit unacceptable electrical losses when used with high speed leadless VLSI chip package technology. Effort is underway investigating tailorable coefficient of thermal expansion multilayer printed wiring boards using random fiber reinforcement and low dielectric constant resins. Present day solders exhibit problems with cracking and thermal degradation. A R&D program is characterizing and developing new solder materials. The program is concentrating on materials for improved thermal fatigue resistance as well as characterizing the intermetallic compounds.

3.4.3 Ongoing ManTech Efforts

An ongoing efort with Rockwell (F33615-81-C-5108) is a follow-on effort to that discussed earlier. The objective of the project is to optimize the acid copper and electroless copper PWB production plating operations by the characterization of the system in a production environment specifically at ten different facilities. CVS and RC analysis of the copper baths indicate good control of the bath additives. It has been demonstrated that it is indeed possible to control contaminate levels and the deposit properties.

3.4.4 Future Efforts

A planned FY85 program will integrate solder and PWB properties with VHSIC electrical requirements. Part of the program will involve the material and manufacturing issues involved in fabricating PWBs having controlled electrical/mechanical characteristics which are compatible with VHSIC device and packaging technology. The program is intended to build on previously funded AF ManTech program efforts. it will include the establishment of material/process property characteristics needed to repeatably fabricate PWBs having controlled mechanical, electrical, thermal, and environmental characteristics for VHSIC capabilities. Program emphasis will include the characterization/understanding of material/process interrelationships, the identification of

the key independent and dependent manufacturing parameters, and the synergistic effects which are typically found in a PWB manufacturing sequence. The primary goals of the program are to establish the engineering trade-offs and to establish the materials, processes, equipment, and process control methodology required for VHSIC PWBs. Problems in laminate dimensional stability, etching, plating, fine line circuits, and small via formation shall be included. Another part of the program will involve a comprehensive review of solder technology including solder materials, processing methods with emphasis on reflow techniques, mechanical, electrical and thermal performance of solders when utilized in surface mounted technology (SMT). The approach to mechanical performance should deal with realistic package to board conditions rather than bulk solder measurements which have been prevalent in the past. The approach to electrical and thermal performance should emphasize material and residual stress changes that occur with time and with the aging characteristics of solder materials.

3.5 PRINTED WIRING ASSEMBLIES

3.5.1 Past ManTech Efforts

The objective of a program with Rockwell (F33615-78-C-5138) was to establish conformal coating manufacturing processes, techniques and controls for reliably coating printed wiring board electric assemblies. Specific goals were to simplify coating rework and repair techniques as well as a reduction of the associated maintainability costs. A comprehensive literature survey and analysis of PWB coatings was done. The output of the survey was the identification and selection of a class of a solder mask/conformal coating system which offers improvements in both maintainability and performance. Verification testing of the electrical and environmental performance of solder mask, solvent soluble conformal coating systems for the Maverick system were completed. Test assemblies were prepared and then they were accelerated stress tested.

Two efforts are ongoing which support the hybrid area. The first

with Boeing (F33615-80-C-5010) is establishing low cost hybrid circuit intraconnection manufacturing processes by applying aluminum wire bonds to thick gold films on multilayer ceramic substrates. The application of these hybrid modules is in the MX guidance and control system.

Two efforts were funded with Hughes at Culver City to examine the use of coatings to protect the interior of hybrid circuits from loose metallic particles. These particles had been the suspected cause of failure in several space applications. These contracts were aimed at coating the inside of hybrid and power transistor packages prior to being lidded. One effort concentrated on organic coatings (F33615-76-C-5273) particularly silicones; the other effort (F33615-78-C-5049) dealt with establishing the production processes for applying a dense, amorphous silicon nitride film by a low temperature photochemical technique. The contract results indicated that the failure rates of the coated packages did not improve dramatically. This coupled with the reluctance of the Program Offices to allow the coating to be placed inside the package resulted in an increased reliance on adequate Particle Impact Noise screening. The silicon nitride work did demonstrate the production feasibility of using the photochemical process. Effort is continuing in applications to solar cells and other Gallium Arsenide devices.

3.5.2 Ongoing AFWAL R&D Efforts

Related activities are described in Section 3.4.2.

3.5.3 Ongoing ManTech Efforts

A contract with Hughes Aircraft (F33615-82-C-5006) is establishing design criteria for a noncontacting automatic infrared testing and inspection system for the fault isolation of power related problems on printed wiring boards and assemblies. The equipment will be demonstrated and delivered to Sacramento Air Logistics Center for implementation.

The use of hermetic chip carriers on printed wiring boards is a critical technology area. A program with a coalition headed by Texas Instruments (F33615-82-C-5071) is establishing the manufacturing techniques which will provide a reliable interconnection between the PWB and chip carrier. In Phase I, potential HCC compatible PWBs were identified. The coalition enlisted the support of a significant portion of the aerospace industry to identify not only possible candidates but the performance demonstrated by each of the technologies. Twenty-five (25) candidate technologies were identified as part of Phase I. Following the identification of all potentially compatible PWB systems, the coalition developed a rating system designed to provide an objective means of evaluating each of the candidates. The requirements of a "typical" PWB were identified and allowed the coalition to define PWB parameters that contribute to meeting the requirements. Not all PWB parameters were a function of the technology selected, so only those characteristics which differ with the type of PWB were considered.

Phase II of the contract will consist of two tasks. In the first task the objective is to evaluate each of the candidates performance, in test and in manufacturing, against all other candidates. The evaluation tests will consist of thermal shock and humidity testing. Based on the performance of all test PWBs, the coalition will narrow the field down to two acceptable HCC compatible PWB technologies for Phase III.

In the second task of Phase II, the coalition will perform more detailed testing of the two selected technologies to demonstrate more fully their performance capabilities. Thermal cycling, mechanical shock, and vibration testing will be performed on test assemblies to better assess the PWB performance.

In the final phase of the contract (Phase III), electrically functional PWBs will be fabricated in each of the coalition member's facilities to demonstrate the compatibility of the chosen PWB technologies

with actual circuits as well as to demonstrate the insertability of the PWB manufacturing technologies into aerospace manufacturing facilities.

3.5.4 Future Efforts

For related projects, see Section 3.4.4.

3.6 WIRE HARNESS/CABLE

3.6.1 Past ManTech Efforts

An effort with General Dynamics (F33615-79-C-5056) produced a computer controlled automated wire preparation system for reducing the cost of fabricating F-16 electrical trunk harness subassemblies. Wires used were automatically selected, cut to length, coiled, identified, and connector contacts installed.

3.6.2 Ongoing ManTech Efforts

A program was awarded in January 1985 to optimize the manufacturing processes necessary to produce hermetically sealed light emitting diode modules for use in military fiber optic applications.

3.6.3 Future Eforts

No programs are planned in this area in the immediate future.

3.7 INTEGRATION

3.7.1 Past ManTech Efforts

A program that was tri-service funded with Battelle (MIPR-81-00010; Army Contract DAAH01-81-D-A015) addressed electronic subsystem manufacturing through the application of the AF CAD/CAM architecture. The program consisted of three major tasks. Task 1 was devoted to planning the program and training personnel. The second task was devoted to preparing functional descriptions of current practice in manufacturing a variety of electronic commodities. These functional descriptions are designated as "AS IS" architectures. In Task 2, some work was done to lay the basis for preparing the functional descriptions of manufacturing

these same commodities in the future. These functional descriptions of future manufacturing are designated "TO BE" architectures. In Task 3, these "TO BE" architectures were prepared. In addition, consideration was given to the question of what should be done to bring about implementation of these future manufacturing systems. This consideration has involved two elements: 1) identification of a number of development projects which are required, and 2) outlining of strategies (which make use of the proposed program elements) to achieve the objective of productivity improvement. To support this strategy development, an analysis has been made of where the money is spent in electronic manufacturing and what are the prospects for improvement in each area by use of increased automation and integrated manufacturing.

3.7.2 Ongoing ManTech Efforts

A program with Westinghouse (F33615-80-C-5159) is establishing low cost and reliable manufacturing processes and materials which are necessary for the fabrication of ground based electronic chassis. The first phase of the program is emphasizing the application of CAD/CAM. New nonmetallic materials are being utilized in the construction to replace metal panels and structural frames. Adhesive bonding techniques are being optimized to replace welding, riveting and brazing processes. The advantages and disadvantages of standard versus nonstandard parts are being reviewed. The second phase consists of the fabrication of chassis in a production environment. Performance, reliability and cost reduction improvements will be verified during a production run.

A project to conceptually design an Improved Electronics Repair Center (ERC) for Sacramento Air Logistic Center (SM-ALC) began in April 1984. The prime contractor is Westinghouse Electric Corporation (F33-615-83-C-5009). The objective of the project is to establish a conceptual design and an implementation plan/schedule for improving repair methods and procedures at the SM-ALC Electronic Repair Center. The Electronics Repair Center must be able to support the forecasted AF re-

quirements in the 1990 and beyond time frame. The overall plan for the project is in three major steps: The first step is to analyze operations. The project team will survey all ground systems currently supported and maintained by SM-ALC-MAI as well as all systems planned for induction into the center over the next five years. The ground systems forecasted for support through the 1990's will also be identified through coordination with the product divisions XR offices.

The second step is to define requirements. Each ground system will be assessed to determine the kind of technologies included. (Example - VHSIC, VLSI, Lasers, Fiber Optics, PWB, etc.) The resultant list of ground systems will be ranked to identify prevalent technologies and their anticipated need dates. The ground systems and their technologies will be compared against the facilities and process in place or planned for SM-ALC-MAI to identify voids or inadequate capability. This process will establish the required technologies.

The third step is to design an improved ERC. An overall functional architecture of the "to be" ERC will be constructed using IDEF0, the functional modeling methodology. This architecture will identify subsystems, performance characteristics for hardware and software, functional and physical interfaces, design and construction standards, documentation, and facilities. Implementation will also be covered in terms of training, installation, quality assurance, test and preparation requirements. Westinghouse will develop an overall implementation plan that includes all selected modernization projects.

The contractor is currently in the process of completing the needs analysis. This effort has included developing functional models which correspond to the operation level for the purpose of documenting needs of the ERC.

3.7.3 Future Efforts

The Air Force plans to initiate a major program in 1985 that will address the horizontal and vertical integration of electronics aerospace manufacturing. The approach is to involve a contractor team (prime and subs) to address the prime/sub/vendor logistics integration (horizontal) and the design through manufacturing to logistics integration (vertical). The objective of this program is to increase manufacturing, productivity and quality, reduce electronics subsystem costs, improve prime-to-vendor interfaces and generate a closer link between prime aerospace subsystem developers and logistic support. The program will consist of five major tasks, which are as follows: Program Baseline Definition; Prime/Sub/Vendor Logistics Integration; Computer Aided Design Manufacturing and Assembly and Test (CADMAT) Integration; IEF Demonstration(s); and finally IEF Management, Technology Transfer and Benefits Tracking.

3.8 POWER SOURCES

3.8.1 Past ManTech Efforts

The Air Force Materials Laboratory in the late 1960's was instrumental in doing inhouse and contracted research in the area of rare earth magnets. After this family of new magnetic materials were demonstrated in the laboratory, the Manufacturing Technology Division funded some of the first efforts to demonstrate the manufacturability of these materials. Efforts with Raytheon (F33615-73-C-5059) proved that these materials could be successfully produced for specific device applications such as jet fuel starters and actuator pump motors. Manufacturing processes were demonstrated for the application of these magnets in airborne electric motors. The methods were implemented in a manufacturing environment and a large number of magnets were produced. A jet fuel starter motor was designed to take advantage of the high energy, high coercivity samarium cobalt magnets. The performance exceeded design expectations.

A program with Crucible Steel (F33615-78-C-5013) demonstrated manufacturing methods for the production of intrinsically temperature compensated, highly stable rare earth cobalt magnets for TWTs and inertial devices. By substitutional alloying of the $SmCo_5$ with selected heavy rare earth elements, the slope of the magnetization versus temperature curve can be varied from negative to positive values. The elimination of the composition gradients, strains and oxygen impurities of the magnets eliminates the major causes of time related instabilities for the magnets.

The production of multifilament niobium tin superconductor wire for aircraft higher power electrical generators was demonstrated during a program with Intermagnetics General (F33615-75-C-5104). Manufacturing techniques for the characterization, optimization and scale up of previous laboratory methods were completed for the Nb_3Sn material system. The wire was extruded from bronze billets. Problems associated with sticking and warping of the coiled wire were addressed.

High voltage power supplies have been a historic problem area. Many of the manufacturing processes have been more of an art than a science. A program funded with Westinghouse (F33615-77-C-5017) optimized processes and techniques used in the encapsulation of space high voltage power supplies. Throughout the program, Westinghouse emphasized the unique spaceborne encapsulation requirements for power supplies operating in the 1 to 10 kilovolt range. The major tasks in this program were: 1) a comprehensive industry and literature survey, 2) investigation of materials and processes, 3) investigation of packaging configurations, 4) fabrication of two spaceborne DMSP power supplies, and 5) life-cycle cost analysis. As a result of these investigations, materials and process specifications were prepared and a guideline document was written. The major program achievements were 1) a new high performance encapsulating and impregnating material and specification offering significant improvements in arc and track resistance, thermal

expansion, adhesive bond strenth to all substrates, filler impurity levels, viscosity, working life, transformer and coil impregnating characteristics and other properties found critical for both spaceborne and airborne high voltage power supplies; 2) a repairable encapsulating material and specification offering optimum overall material properties and availability for both spaceborne and airborne high voltage power supplies; 3) reliable, controllable, high yield manufacturing processes and specifications for application of both types of materials listed above; and 4) a practical and broadly useful guidelines document based on the above achievements and associated findings in this program.

An airborne high voltage power supply encapsulation program was initiated with Boeing (F33615-77-C-5015). Boeing evaluated eighty (80) different encapsulation materials for electrical and processing/manufacturing characteristics and found silastic E and stycast 2651 to be the best encapsulation materials. Manufacturing encapsulation techniques, process parameters and process controls were established for both encapsulants. Boeing demonstrated the improvements possible with this technology using the B-52 electro optical viewing system (EVS) high voltage power supply. The B-52 EVS power supply MTBF was improved from 1,000 hours to 10,000 hours with verification of this improvement by flight testing at Warner Robins Air Force Base.

A second program with Boeing (F33615-80-C-5171) optimized high voltage encapsulation techniques and integrated them with qualification/testing standards to reduce both manufacturing costs and life cycle costs. Major areas of emphasis included improvements in encapsulation techniques and process controls for modular/high density configurations, stress reduction of the encapsulant by appropriate design analysis and layout, and improved package testability.

The objective of a project with Honeywell (F33615-76-C-5261) was to establish an automated production capability to produce a family of

standard sized non-reserve lithium anode-organic electrolyte cells. These cells (AA, A, C and D) were hermetically sealed lithium-sulfur dioxide. Because they are to be used in Air Force life support equipment high integrity, reliability and safety features were emphasized during the program.

Nickel cadmium batteries were manufactured during a program with Eagle Picher (F33615-76-C-5407) using new electrochemical impregnation techniques. Processes developed by the Propulsion Laboratory of AFWAL were used to establish the required manufacturing methods.

Funding was provided to the Navy (MIPR-80-00008) at the Naval Surface Weapons Center to investigate the production of lithium-boron anode material for use in advanced thermal battery systems. A joint Navy effort with General Electric Neutron Devices Operation scaled up a laboratory method for preparing LiB 450 gram ingots. The boron particle size was determined not be a critical factor in the production. Single cell tests showed no degradation in performance of the production material versus the laboratory specimens.

3.8.2 Ongoing ManTech Efforts

Low cost manufacturing methods are necessary for the production of space qualified gallium arsenide solar cells. Goals of program with Applied Solar Energy Corporation (F33615-81-C-5150) are to: 1) produce space qualified gallium arsenide solar cells with a 50% yield with a minimum conversion efficiency of 16%; 2) demonstrate a production rate of 1000 cells per week, expandable to 5000 cells per week of 2cm x 2cm cells; 3) the cost per qualified cell is less than $40.00. Present efforts are directed towards improving run to run consistency, contacting, and defining the role of substrate quality.

Nickel hydrogen systems offer the possibility of 50 amp-hour batteries with an usable energy density of 9-16 watt-hours/pound

ending on frequency and depth of discharge. The first phase of the gram with Yardney (F33615-80-C-5036) was a critical review of cell ign, production parameters with emphasis on cost reduction. The ond phase obtained special tooling, tested production techniques at component level, and assembled sample cells to design specificat- s. The third phase is demonstrating space quality cells to design performance specifications. A set of batteries will be lifetested.

A recently awarded contract to Eagle Picher (F33615-84-C-5064) is ng to produce high energy density thermal batteries with a 20% cost luction. The batteries will be capable of supplying peak power for 80 conds in extreme temperature environments and have short activation nes which are required to missile applications.

3.3 Future Efforts

Power for satellites include power storage by batteries and battery charging by solar cells. Effort in the solar cell area will be ex- nded to include automated process controls, cell testing, material ndling, and high reliability interconnect technology. A 50% reduction direct labor is expected if robotics are used to position and manipu- te the solar cells and circuit elements for soldering by a computer ntrolled laser. Future efforts will address the needs for process ntrols for milti-band high efficiency.

Power transfer within the satellite is accomplished by the use of mplex cable and harness assemblies. This area has been typically an ea of concern for radiation protection. Radiation tolerance of cable d harness assemblies in satellites is largely dependent upon the ble/harness materials and geometries. Specific process improvements r cable/harness fabrication will be made as a function of materials, re terminations, cable assemblies, and manner of installation in the acecraft.

OPTICS-DETECTORS

TITLE : MT FOR IR FOCAL PLANE ARRAY TESTING
CONTRACTOR : ROCKWELL INTERNATIONAL THOUSAND OAKS CA
CONTRACT# : F33615-79-C-5040 CLOSED
APPROPRIATION : 3020 AMOUNT IN $ X 1000 : $ 1273
MISSION : C.C.C.I.
THRUST : SPACE SYSTEMS

PROJECT OBJECTIVE

THE OBJECTIVE IS TO ESTABLISH AN AUTOMATED PRODUCTION TEST CAPABILITY FOR INTEGRATED FOCAL PLANE ARRAYS (IFPAS) OF INFRARED DETECTORS. THE IFPAS TO BE TESTED HAVE SIGNAL PROCESSING ELECTRONICS ON THE SAME CHIP AS THE SENSITIVE ELEMENTS OR ON AN INTIMATELY CONNECTED CHIP. IFPA TESTING THROUGHPUT IS A CRITICAL DEFICIENCY IN MEETING PROJECTED PRODUCTION NEEDS, IN ADDITION TO REDUCING IFPA COST IN PRODUCTION.

TITLE : NON-LINEAR MATERIALS DESIGN AND SCALE UP II
CONTRACTOR : VOUGHT CORP. DALLAS TX
CONTRACT# : F33615-80-C-5009 CLOSED
APPROPRIATION : 3020 AMOUNT IN $ X 1000 : $ 613
MISSION : C.C.C.I.
THRUST : SPACE SYSTEMS

PROJECT OBJECTIVE

TO ESTABLISH THE MANUFACTURING PROCESSES FOR NON-LINEAR MATERIALS FOR SPACEBORNE OPTICAL AND THERMAL CONTROL SYSTEMS, SO THAT THESE NON-LINEAR MATERIALS CAN BE APPLIED TO OPTICAL AND THERMAL CONTROL SUBSTRATES WHILE WHILE MAINTAINING HIGH YIELD.

OPTICS-DETECTORS

TITLE : MT FOR DETECTOR GRADE INTRINSIC SILICON
CONTRACTOR : HUGHES CARLSBAD CA
CONTRACT# : F33615-79-C-5142 CLOSED
APPROPRIATION : 3020 AMOUNT IN $ X 1000 : $ 1100
MISSION : TACTICAL WARFARE
THRUST : TACTICAL SYSTEMS

PROJECT OBJECTIVE

TO ESTABLISH A HIGHLY RELIABLE AND SAFE AUTOMATION COMPATIBLE ZONER FOR THE ECONOMIC PRODUCTION OF INTRINSIC SILICON FOR THE FABRICATION OF 1.06 MICROMETER DETECTORS, AND TO ENSURE A DOMESTIC CAPABILITY IS MAINTAINED TO SATISFY DOD MATERIAL REQUIREMENTS. THE SPECIFIC OBJECTIVES ARE TO ESTABLISH A PROTOTYPE AUTOMATION COMPATIBLE ZONER. TO OBTAIN HIGHER YIELDS FOR 2.54 CM. P-TYPE INTRINSIC SILICON RESIS.BTWN.9,000/30,000 OHM

TITLE : IR MAVERICK DETECTOR ARRAYS
CONTRACTOR : HONEYWELL INC. LEXINGTON MA
CONTRACT# : F33615-82-C-5085 CLOSED
APPROPRIATION : 3020 AMOUNT IN $ X 1000 : $ 968
MISSION : TACTICAL WARFARE
THRUST : TACTICAL SYSTEMS

PROJECT OBJECTIVE

THE OBJECTIVE OF THIS PROGRAM IS TO OPTIMIZE AND ESTABLISH SELECTED MANUFACTURING PROCESSES AND TEST TECHNIQUES FOR 16 ELEMENT PHOTOCONDUCTIVE, HGCDTE DETECTOR ARRAY DEWAR ASSEMBLIES FOR USE IN IR MAVERICK MISSILE. THESE ARRAYS MUST MEET PERFORMANCE REQUIREMENTS NECESSARY FOR THE AGM-65D.

OPTICS-RADOMES

TITLE : MT FOR ZINC SULFIDE IR DOME
CONTRACTOR : RAYTHEON WALTHAM MA
CONTRACT# : F33615-76-C-5256 CLOSED
APPROPRIATION : 3080 AMOUNT IN $ X 1000 : $ 247
MISSION : TACTICAL WARFARE
THRUST : TACTICAL SYSTEMS

PROJECT OBJECTIVE

THE ESTABLISHMENT OF A HIGH PRODUCTION RATE MANUFACTURING PROCESS FOR THE FABRICATION OF SPHERICAL DOMES OF ZINC SULFIDE.

OPTICS-WINDOWS

TITLE : MT FOR ZINC SELENIDE LASER WINDOWS
CONTRACTOR : RAYTHEON WALTHAM MA
CONTRACT# : F33615-73-C-5141 CLOSED
APPROPRIATION : 3080 AMOUNT IN $ X 1000 : $ 1544
MISSION : TACTICAL WARFARE
THRUST : TACTICAL SYSTEMS

PROJECT OBJECTIVE

TO ESTABLISH A PRODUCTION PROCESS FOR THE MANUFACTURE OF LARGE ZINC SELENIDE INFRARED LASER WINDOWS WITH LOW OPTICAL ABSORPTION AND HIGH OPTICAL HOMOGENEITY. THE DETAILS OF THE INTENDED APPLICATION ARE CLASSIFIED SECRET.

TITLE : MT FOR NUMERICALLY CONTROLLED MACHINING OF INFRARED
CONTRACTOR : HONEYWELL INC. LEXINGTON MA
CONTRACT# : F33615-78-C-5130 CLOSED
APPROPRIATION : 3010 AMOUNT IN $ X 1000 : $ 700
MISSION : TACTICAL WARFARE
THRUST : TACTICAL SYSTEMS

PROJECT OBJECTIVE

TO TRANSFER THE TECHNOLOGY OF NUMERICALLY-CONTROLLED (N/C) PRECISION MACHINING OF OPTICAL COMPONENTS AND DIES TO INDUSTRY IN ORDER TO TAKE ADVANTAGE OF SIGNIFICANT COST SAVINGS IN THE PRODUCTION OF CURRENT AND FUTURE AF AND DOD THERMAL IMAGING SYSTEMS. A PILOT PRODUCTION FACILITY WILL EFFECT THE TRANSFER AND TEST THE RESULTANT LEARNING ON PRODUCTION OF ASPHERIC OPTICAL COMPONENTS & PROVIDE REPORTS TO OTHER GOV'T CONTRACT

OPTICS-WINDOWS

TITLE : ZN SE/ZNS SANDWICH TYPE FLIR
CONTRACTOR : RAYTHEON WALTHAM MA
CONTRACT# : F33615-80-C-5013 CLOSED
APPROPRIATION : 3010 AMOUNT IN $ X 1000 : $ 967
MISSION : TACTICAL WARFARE
THRUST : TACTICAL SYSTEMS

PROJECT OBJECTIVE

ESTABLISH RELIABLE PRODUCTION PROCESSES FOR LARGE 14 INCHES x 20 INCHES x 3/4 INCHES SANDWICH TYPE FLIR WINDOWS USING A ZINC SELENIDE (ZNSE) SUBSTRATE WITH A DEPOSITED OVERCOATING OF ZINC SULFIDE (ZNS). THE OPTIMIZED MANUFACTURING PROCESSES SHALL BE COST EFFECTIVE AND SHALL BE CAPABLE OF PRODUCING 16-20 LARGE WINDOWS PER FURNACE RUN.

TITLE : MT FOR FLIR FABRICATION AND ASSEMBLY
CONTRACTOR : HONEYWELL INC. LEXINGTON MA
CONTRACT# : F33615-75-C-5042 CLOSED
APPROPRIATION : 3010 AMOUNT IN $ X 1000 : $ 500
MISSION : TACTICAL WARFARE
THRUST : TACTICAL SYSTEMS

PROJECT OBJECTIVE

TO IMPROVE OR DEVELOP NEW FABRICATION AND ASSEMBLY TECHNIQUES FOR THE SYSTEM OR SUBSYSTEM SHOWING THE BEST PROMISE OF HAVING THE GREATEST POSS IBILITY OF COST REDUCTION POTENTIAL. TO IDENTIFY THE SPECIFIC AREAS WHICH OFFER GREATEST POTENTIAL OF COST REDUCTION AND DEVELOP AND APPLY NEW OR IMPROVED MANUFACTURING METHODS TO DEMONSTRATE THE COST REDUCTION.

PRINTED WIRE ASSEMBLIES

TITLE : MT FOR SILICON NITRIDE LOW TEMP PASSIVATION
CONTRACTOR : HUGHES CULVER CITY CA
CONTRACT# : F33615-78-C-5049 CLOSED
APPROPRIATION : 3010 AMOUNT IN $ X 1000 : $ 400
MISSION : GENERIC
THRUST : ELECTRONICS

PROJECT OBJECTIVE

THE OBJECTIVE OF THIS PROGRAM IS TO ESTABLISH THE PRODUCTION PROCESSES AND TECHNIQUES FOR THE DEPOSITION OF A DENSE, AMORPHOUS SILICON NITRIDE FILM ON VARIOUS MICROELECTRONIC DEVICES. THE METHOD OF DEPOSITION WILL BE A LOW TEMPERATURE PHOTOCHEMICAL (PHOTOLYSIS) REACTION.

PROJECT CROSS REFERENCE BY TECHNICAL AREA

PROJECT CROSS REFERENCE BY TECHNICAL AREA

PROJECT CROSS REFERENCE BY CONTRACTOR NAME

PROJECT CROSS REFERENCE BY CONTRACTOR NAME

APPENDIX B

ELECTRONICS PROJECT ABSTRACTS
BY TECHNICAL AREA

MANTECH ELECTRONICS PROJECTS -- USAF SUPPORT SUMMARY

PRODUCT DIVISIONS: AD-ARMAMENTS ASD-AERONAUTICAL SYSTEMS AFLC-AIR FORCE LOGISTICS COMMAND BMO-BALLISTIC MISSILE ORGANIZATION
SD-SPACE G-GENERIC ESD-ELECTRONIC SYSTEMS DIVISION

PROJECT TITLE	TECHNICAL AREA	MISSION	THRUST	PRODUCT DIV.
MT FOR IJ BAND TWT AMPLIFIER	MICROWAVE - TWT	ELECTRONIC COMB	ELECTRONICS	ASD
I/J BAND AMPLIFIER	MICROWAVE - TWT	ELECTRONIC COMB	ELECTRONICS	ASD
DUAL MODE TRAVELING WAVE TUBE	MICROWAVE - TWT	ELECTRONIC COMB	ELECTRONICS	ASD
MT FOR BEAM TESTER	MICROWAVE - TWT	ELECTRONIC COMB	ELECTRONICS	ASD
MT FOR MINI TWTS FOR PHASED ARRAY	MICROWAVE - TWT	ELECTRONIC COMB	ELECTRONICS	ASD
MM FOR MINIATURE TWT	MICROWAVE - TWT	ELECTRONIC COMB	ELECTRONICS	ASD
IMPROVED ELECTRON GUNS	MICROWAVE - TWT	ELECTRONIC COMB	ELECTRONICS	ASD
MT FOR MILLIMETER TWT	MICROWAVE - TWT	C.C.C.I.	ELECTRONICS	ESD
MT FOR ADVANCED DISPENSER CATHODES	MICROWAVE - TWT	C.C.C.I.	SPACE SYSTEMS	SD
TWT AMPLIFIER TECHNOLOGY FOR SPACE SYSTEMS	MICROWAVE - TWT	C.C.C.I.	SPACE SYSTEMS	SD
MT FOR STANDARDIZED COAXIAL MAGNETRONS	MICROWAVE - TWT	C.C.C.I.	ELECTRONICS	ASD
MT FOR HGCDTE DETECTOR ARRAYS	OPTICS-DETECTOR	TACTICAL WARFAR	TACTICAL SYSTEM	ASD
DETECTOR GRADE SILICON	OPTICS-DETECTOR	TACTICAL WARFAR	TACTICAL SYSTEM	ASD
MT FOR IR FOCAL PLANE ARRAY TESTING	OPTICS-DETECTOR	C.C.C.I.	SPACE SYSTEMS	SD
IR MAVERICK DETECTOR ARRAYS	OPTICS-DETECTOR	TACTICAL WARFAR	TACTICAL SYSTEM	ASD
NON-LINEAR MATERIALS DESIGN AND SCALE UP II	OPTICS-DETECTOR	C.C.C.I.	SPACE SYSTEMS	SD
MT FOR DETECTOR GRADE INTRINSIC SILICON	OPTICS-DETECTOR	TACTICAL WARFAR	TACTICAL SYSTEM	ASD
IR MAVERICK DETECTOR ARRAYS	OPTICS-DETECTOR	TACTICAL WARFAR	TACTICAL SYSTEM	ASD
MT FOR ZINC SULFIDE IR DOME	OPTICS-RADOMES	TACTICAL WARFAR	TACTICAL SYSTEM	ASD
ZN SE/ZNS SANDWICH TYPE FLIR	OPTICS-WINDOWS	TACTICAL WARFAR	TACTICAL SYSTEM	ASD
MT FOR NUMERICALLY CONTROLLED MACHINING OF INFRARED	OPTICS-WINDOWS	TACTICAL WARFAR	TACTICAL SYSTEM	ASD
MT FOR FLIR FABRICATION AND ASSEMBLY	OPTICS-WINDOWS	TACTICAL WARFAR	TACTICAL SYSTEM	ASD
MT FOR ZINC SELENIDE LASER WINDOWS	OPTICS-WINDOWS	TACTICAL WARFAR	TACTICAL SYSTEM	ASD
MT FOR NICKEL-CADMIUM BATTERIES	POWER - BATTERI	TACTICAL WARFAR	TACTICAL SYSTEM	ASD
MT FOR THERMAL BATTERY PRODUCTION	POWER - BATTERI	TACTICAL WARFAR	TACTICAL SYSTEM	AD
LITHIUM BATTERIES FOR LIFE SUPPORT APPLICATIONS	POWER - BATTERI	GENERIC	ELECTRONICS	ASD
MT FOR LITHIUM BORON (LIB) ALLOYS	POWER - BATTERI	TACTICAL WARFAR	TACTICAL SYSTEM	AD
MT FOR NICKEL-HYDROGEN BATTERY CELLS	POWER - BATTERI	C.C.C.I.	SPACE SYSTEMS	SD
TEMPERATURE COMPENSATED MAGNETS	POWER - MAGNETS	ELECTRONIC COMB	ELECTRONICS	ASD
DEVICE APPLICATIONS FOR LOW COST RARE EARTH COBALT MAGNETS	POWER - MAGNETS	TACTICAL WARFAR	TACTICAL SYSTEM	ASD
MT FOR GALLIUM ARSENIDE (GAAS) SOLAR CELLS	POWER - SOLAR C	C.C.C.I.	SPACE SYSTEMS	SD
MT FOR FINE FILAMENT SUPERCONDUCTIVE WIRE	POWER SUPPLIES	GENERIC	ELECTRONICS	ASD
SPACE HIGH VOLTAGE POWER SUPPLIES	POWER SUPPLIES	C.C.C.I.	SPACE SYSTEMS	SD
AIRBORNE HIGH VOLTAGE POWER SUPPLIES	POWER SUPPLIES	GENERIC	ELECTRONICS	ASD
MT FOR IMPROVED HIGH VOLTAGE PWR SUPPLY PACKAGING	POWER SUPPLIES	GENERIC	ELECTRONICS	ASD
REPAIR OF CONFORMALLY COATED PRINTED WIRING BOARDS	PRINTED WIRE AS	GENERIC	ELECTRONICS	G
MT FOR HIGH REL WIRE BONDING IN HYBRID CIRCUITS	PRINTED WIRE AS	STRATEGIC OFFEN	STRATEGIC MISSI	BMO
MT FOR ELIM OF LOOSE METAL PART IN MICRO PKG	PRINTED WIRE AS	GENERIC	ELECTRONICS	SD
MT FOR CONFORMAL COATING	PRINTED WIRE AS	GENERIC	ELECTRONICS	G
HIGH RELIABILITY PKG USING HCCS WITH COMPATIBLE PWBS	PRINTED WIRE AS	GENERIC	ELECTRONICS	G
MT FOR HIGH SPEED DIGITAL PROCESSING PKG	PRINTED WIRE AS	TACTICAL WARFAR	TACTICAL SYSTEM	ASD
AUTOMATED INSPECTION OF PWAS	PRINTED WIRE AS	GENERIC	ELECTRONICS	G
MT FOR SILICON NITRIDE LOW TEMP PASSIVATION	PRINTED WIRE AS	GENERIC	ELECTRONICS	G
MT FOR PWB ELECTRO DEPOSITION PROCESS CONTROL	PRINTED WIRING	GENERIC	ELECTRONICS	G
MT FOR PWB ELECTRO DEPOSITION PROCESSES	PRINTED WIRING	GENERIC	ELECTRONICS	G
MT FOR THICK FILM CERAMIC CIRCUIT CARDS	PRINTED WIRING	TACTICAL WARFAR	TACTICAL SYSTEM	AD
MT FOR PRINTED WIRING BOARD PROCESSES/CONTROL	PRINTED WIRING	GENERIC	ELECTRONICS	G
MT FOR COPPER MULTI-LAYER CERAMIC CARDS	PRINTED WIRING	TACTICAL WARFAR	TACTICAL SYSTEM	AD
IMPROVED MANUFACTURING PROCESS FOR POLYIMIDE PRINTED CIRCUIT	PRINTED WIRING	GENERIC	ELECTRONICS	G
MT FOR DIRECT PATTERN GENERATION OF PWB	PRINTED WIRING	GENERIC	ELECTRONICS	G

MANTECH ELECTRONICS PROJECTS -- USAF SUPPORT SUMMARY

PRODUCT DIVISIONS: AD-ARMAMENTS ASD-AERONAUTICAL SYSTEMS AFLC-AIR FORCE LOGISTICS COMMAND BMD-BALLISTIC MISSILE ORGANIZATION SD-SPACE G-GENERIC ESD-ELECTRONIC SYSTEMS DIVISION

PROJECT TITLE	TECHNICAL AREA	MISSION	THRUST	PRODUCT DIV.
MT FOR COMPUTERIZED WIRE KIT PREP	HARNESS AND CAB	TACTICAL WARFAR	ELECTRONICS	ASD
MT FOR FIBER OPTIC EMITTERS	HARNESS AND CAB	TACTICAL WARFAR	ELECTRONICS	ASD
RADIATION HARDENED INTEGRATED CIRCUITS	INTEGRATED CIRC	C.C.C.I.	SPACE SYSTEMS	SD
RADIATION HARDENED MULTIPLE IC PACKAGE	INTEGRATED CIRC	C.C.C.I.	SPACE SYSTEMS	SD
MT FOR LARGE SCALE IC PRODUCT TESTING	INTEGRATED CIRC	C.C.C.I.	SPACE SYSTEMS	G
MT FOR MICROCOMPUTER FUZE	INTEGRATED CIRC	TACTICAL WARFAR	TACTICAL SYSTEM	ASD
ADVANCED BUBBLE DOMAIN MATERIALS	INTEGRATED CIRC	C.C.C.I.	SPACE SYSTEMS	SD
MT FOR LOW COST CHIP CARRIER	INTEGRATED CIRC	GENERIC	ELECTRONICS	G
MT FOR SUBSTRATE ASSY W/HERMETIC CHIP CARRIERS	INTEGRATED CIRC	GENERIC	ELECTRONICS	G
MT FOR RADIATION HARDENED A/D CONVERTER CHARACTERIZATION	INTEGRATED CIRC	C.C.C.I.	SPACE SYSTEMS	SD
MOS-FET BIPOLAR INTEGRATED CIRCUITS	INTEGRATED CIRC	GENERIC	ELECTRONICS	G
CHARGE COUPLED DEVICE MEMORY ARRAYS	INTEGRATED CIRC	C.C.C.I.	TACTICAL SYSTEM	ASD
OPERATIONAL AMPLIFIERS FOR MISSILE AND SATELLITES	INTEGRATED CIRC	STRATEGIC OFFEN	STRATEGIC MISSI	BMD
LOGIC ARRAYS FOR SATELLITES	INTEGRATED CIRC	C.C.C.I.	SPACE SYSTEMS	SD
SILICON ON INSULATING SUBSTRATE DEVICES	INTEGRATED CIRC	C.C.C.I.	SPACE SYSTEMS	SD
RADIATION HARDENED CMOS/SOS MICROPROCESSORS	INTEGRATED CIRC	C.C.C.I.	SPACE SYSTEMS	SD
MT FOR HIGH SPEED PROCESSOR	INTEGRATED CIRC	C.C.C.I.	TACTICAL SYSTEM	ASD
NMOS MEMORY FOR SATELLITES	INTEGRATED CIRC	C.C.C.I.	SPACE SYSTEMS	SD
SURFACE INSPECTION TECHNIQUES FOR LSI CIRCUITS	INTEGRATED CIRC	GENERIC	ELECTRONICS	G
MT FOR AUTOMATED CONTROLS FOR CONTINUOUS EPITAXIAL PROCESS	INTEGRATED CIRC	GENERIC	ELECTRONICS	G
INTELL. MFG. SYSTEM FOR ASSY OF SURFACE MOUNT TECH	INTEGRATED CIRC	GENERIC	ELECTRONICS	G
MT FOR HERMETIC CHIP CARRIER	INTEGRATED CIRC	GENERIC	ELECTRONICS	G
MT FOR CMOS/SOS ROM MEMORIES	INTEGRATED CIRC	C.C.C.I.	ELECTRONICS	SD
SURFACE INSPECTION TECHNIQUES FOR LSI PRODUCTION	INTEGRATED CIRC	GENERIC	ELECTRONICS	G
MT FOR CMOS/SOS ROM MEMORIES	INTEGRATED CIRC	C.C.C.I.	SPACE SYSTEMS	SD
PROJECTION MASKING SYSTEM	INTEGRATED CIRC	GENERIC	ELECTRONICS	AD
MT FOR HERMETIC CHIP CARRIER	INTEGRATED CIRC	GENERIC	ELECTRONICS	G
MT FOR NONVOLATILE MEMORY	INTEGRATED CIRC	C.C.C.I.	ELECTRONICS	G
MT FOR MICROPROCESSOR SUPPORT CIRCUITS	INTEGRATED CIRC	C.C.C.I.	SPACE SYSTEMS	SD
MT FOR ELECTRONIC CAD/CAM	INTEGRATION	GENERIC	COMPUTER INTEGR	G
MT FOR SM-ALC ELECTRONIC REPAIR CENTER	INTEGRATION	GENERIC	ELECTRONICS	AFLC
MT FOR IMPROVED MFG PROCESSES/MTLS FOR CHASSIS	INTEGRATION	GENERIC	ELECTRONICS	G
MT FOR PAVE PAWS UHF POWER TRANSISTOR	MICROWAVE - SOL	C.C.C.I.	ELECTRONICS	ESD
MT FOR FIELD EFFECT TRANSISTORS	MICROWAVE - SOL	TACTICAL WARFAR	TACTICAL SYSTEM	AD
MICROWAVE SIGNAL SYNTHESIZER	MICROWAVE - SOL	C.C.C.I.	ELECTRONICS	ASD
GALLIUM ARSENIDE MICROWAVE SUBSTRATES	MICROWAVE - SOL	GENERIC	ELECTRONICS	G
MT FOR FERRITE PHASE CONTROL MODULES	MICROWAVE - SOL	ELECTRONIC COMB	ELECTRONICS	ASD
MT FOR FERRITE PHASERS	MICROWAVE - SOL	ELECTRONIC COMB	ELECTRONICS	ASD
MT FOR GAAS IMPATT DIODES	MICROWAVE - SOL	TACTICAL WARFAR	TACTICAL SYSTEM	AD
PERMANENT MAGNET YIG FILTERS	MICROWAVE - SOL	TACTICAL WARFAR	TACTICAL SYSTEM	AD
GALLIUM ARSENIDE PRODUCTION	MICROWAVE - SOL	GENERIC	ELECTRONICS	G
MT FOR MICROWAVE INTEGRATED CIRCUITS	MICROWAVE - SOL	TACTICAL WARFAR	TACTICAL SYSTEM	G
MT FOR STRESS COMPENSATED CRYSTAL RESONATORS	MICROWAVE - SOL	TACTICAL WARFAR	TACTICAL SYSTEM	AD
MT FOR SOLID STATE TRANSMITTER PRODUCTION PROG	MICROWAVE - SOL	TACTICAL WARFAR	TACTICAL SYSTEM	AD
MM FOR MICROWAVE LIMITER	MICROWAVE - SOL	C.C.C.I.	ELECTRONICS	ASD
MT FOR MILLIMETER WAVE IMPATT DIODES	MICROWAVE - SOL	C.C.C.I.	SPACE SYSTEMS	SD
MT FOR HIGH RELIABILITY OF PKG OF MICS	MICROWAVE - SOL	C.C.C.I.	ELECTRONICS	G
MT FOR PRECISION EXTRUDED ALUMINUM WAVEGUIDES	MICROWAVE - SOL	C.C.C.I.	ELECTRONICS	ESD
MT FOR MICROWAVE INTEGRATED CIRCUITS	MICROWAVE - SOL	TACTICAL WARFAR	TACTICAL SYSTEM	ASD
MT FOR SPACE TWT & TWTA	MICROWAVE - TWT	C.C.C.I.	SPACE SYSTEMS	SD
KLYSTRON POWER AMPLIFIER	MICROWAVE - TWT	C.C.C.I.	ELECTRONICS	ESD
MT FOR EW BAND TWT AMPLIFIER	MICROWAVE - TWT	ELECTRONIC COMB	ELECTRONICS	ASD

APPENDIX A

MANTECH ELECTRONICS PROJECTS
USAF SUPPORT SUMMARY

OPTICS-DETECTORS

TITLE : MT FOR HGCDTE DETECTOR ARRAYS
CONTRACTOR : HONEYWELL INC. LEXINGTON MA
CONTRACT# : F33615-78-C-5035 CLOSED
APPROPRIATION : 3020 AMOUNT IN $ X 1000 : $ 750
MISSION : TACTICAL WARFARE
THRUST : TACTICAL SYSTEMS

PROJECT OBJECTIVE

TO ESTABLISH THE MANUFACTURING PROCESSES AND TECHNIQUES (INCLUDING IN-PROCESS EVALUATION) FOR PRODUCTION OF HGCDTE INFRARED DETECTOR ARRAYS THESE ARRAYS REQUIRE UNIFORMLY HIGH PERFORMANCE AND SPECTRAL CUT-OFF GREATER THAN 3 MICRONS.

TITLE : IR MAVERICK DETECTOR ARRAYS
CONTRACTOR : SANTA BARBARA RESEARCH CENTER GOLETA CA
CONTRACT# : F33615-82-C-5077 CLOSED
APPROPRIATION : 3020 AMOUNT IN $ X 1000 : $ 994
MISSION : TACTICAL WARFARE
THRUST : TACTICAL SYSTEMS

PROJECT OBJECTIVE

THE OBJECTIVE OF THIS PROGRAM IS TO OPTIMIZE AND ESTABLISH SELECTED MANUFACTURING PROCESSES AND TEST TECHNIQUES FOR SIXTEEN (16) ELEMENT PHOTOCONDUCTIVE, HGCDTE DETECTOR ARRAYS FOR USE IN THE IR MAVERICK MISSILE. THESE ARRAYS MUST MEET PERFORMANCE REQUIREMENTS NECESSARY FOR THE AGM-65D.

OPTICS-DETECTORS

TITLE : DETECTOR GRADE SILICON
CONTRACTOR : HUGHES CARLSBAD CA
CONTRACT# : F33615-75-C-5283 CLOSED
APPROPRIATION : 3020 AMOUNT IN $ X 1000 : $ 553
MISSION : TACTICAL WARFARE
THRUST : TACTICAL SYSTEMS

PROJECT OBJECTIVE

TO PROVIDE THE MANUFACTURING PROCESSES FOR THE PRODUCTION ON INTRINSIC SILICON FOR THE FABRICATION OF 1.06 MICROMETER DETECTORS AND TO ESTABLISH A DOMESTIC SOURCE OF THE SILICON. PROCESSES SHALL BE COST EFFECTIVE AND SHALL HAVE THE POTENTIAL FOR SCALE-UP. JOINT PROGRAM WITH THE ARMY.

MICROWAVE - SOLID STATE

TITLE : MT FOR PAVE PAWS UHF POWER TRANSISTOR
CONTRACTOR : M/A COM PHI INC TORRANCE CA
CONTRACT# : F33615-83-C-5070 CLOSED
APPROPRIATION : 3080 AMOUNT IN $ X 1000 : $ 494
MISSION : C.C.C.I.
THRUST : ELECTRONICS

PROJECT OBJECTIVE

TO ESTABLISH IMPROVED MANUFACTURING PROCESSES AND TECHNIQUES FOR UHF POWER TRANSISTORS USED IN PAVE PAWS RADAR SYSTEMS. THE PROGRAM WILL INCREASE PRODUCTION YIELD, REDUCE UNIT COST AND ASSURE AVAILABILITY OF SUFFICIENT QUANTITIES OF THESE DEVICES TO MEET PROJECTED NEEDS FOR THE PLANNED PAVE PAWS EXPANSION PROGRAM.

TITLE : MT FOR FIELD EFFECT TRANSISTORS
CONTRACTOR : RAYTHEON NORTHBORO MA
CONTRACT# : F08635-80-C-0289 CLOSED
APPROPRIATION : 3020 AMOUNT IN $ X 1000 : $ 1025
MISSION : TACTICAL WARFARE
THRUST : TACTICAL SYSTEMS

PROJECT OBJECTIVE

TO ESTABLISH MANUFACTURING METHODS FOR LARGE VOLUME, LOW COST PRODUCTION OF GAAS FIELD EFFECT TRANSISTORS WHICH WERE ORIGINALLY INTENDED AS THE ACTIVE COMPONENT IN THE AMRAAM MISSILE TRANSMITTER.

MICROWAVE - SOLID STATE

TITLE : MT FOR MICROWAVE INTEGRATED CIRCUITS
CONTRACTOR : HUGHES CANOGA PARK CA
CONTRACT# : F08635-80-C-0243 CLOSED
APPROPRIATION : 3020 AMOUNT IN $ X 1000 : $ 1380
MISSION : TACTICAL WARFARE
THRUST : TACTICAL SYSTEMS

PROJECT OBJECTIVE

TO ESTABLISH MANUFACTURING METHODS TO ESTABLISH MECHANIZED AND AUTOMATED PROCESSING, FABRICATION, SCREENING, AND TESTING FOR PRODUCTION VOLUMES OF MICROWAVE INTEGRATED CIRCUITS (MIC) FOR AMRAAM. THE VEHICLE SELECTED FOR THIS MANTECH PROGRAM WAS A MIC COMMONLY USED ON THE SEEKER RF PROCESSOR AND THE DATA LINK RECEIVER.

TITLE : MT FOR FERRITE PHASE CONTROL MODULES
CONTRACTOR : MICROWAVE APPLICATIONS GROUP SANTA MARIA CA
CONTRACT# : F33615-78-C-5106 OPEN
APPROPRIATION : 3010 AMOUNT IN $ X 1000 : $ 382
MISSION : ELECTRONIC COMBAT/RECON.
THRUST : ELECTRONICS

PROJECT OBJECTIVE

TO ESTABLISH THE MANUFACTURING TECHNOLOGY NECESSARY FOR THE HIGH VOLUME LOW-COST PRODUCTION OF PHASE CONTROL MODULES (PCMS) FOR USE IN AIRBORNE ELECTRONIC PHASED ARRAY ANTENNA SYSTEMS. THE PCMS THAT ARE USED IN THE HELRATS AND THE ELECTRONICALLY AGILE RADAR (EAR) WILL BE USED AS THE EVALUATION VEHICLE.

MICROWAVE - SOLID STATE

TITLE : MT FOR GAAS IMPATT DIODES
CONTRACTOR : RAYTHEON BEDFORD MA
CONTRACT# : F08635-80-C-0288 CLOSED
APPROPRIATION : 3020 AMOUNT IN $ X 1000 : $ 1553
MISSION : TACTICAL WARFARE
THRUST : TACTICAL SYSTEMS

PROJECT OBJECTIVE

TO ESTABLISH MANUFACTURING METHODS TO REDUCE THE PRODUCTION COST OF GA AS IMPATT DIODES.

TITLE : PERMANENT MAGNET YIG FILTERS
CONTRACTOR : RAYTHEON BEDFORD MA
CONTRACT# : F08635-80-C-0175 CLOSED
APPROPRIATION : 3020 AMOUNT IN $ X 1000 : $ 711
MISSION : TACTICAL WARFARE
THRUST : TACTICAL SYSTEMS

PROJECT OBJECTIVE

TO ESTABLISH THE MANUFACTURING TECHNOLOGY TO ENHANCE THE PRODUCABILITY OF YTRIUM-IRON-GARNET (YIG) FILTERS FOR USE IN MONOPULSE RADARS FOR MISSILE APPLICATIONS.

MICROWAVE - SOLID STATE

TITLE : MT FOR MICROWAVE INTEGRATED CIRCUITS
CONTRACTOR : RAYTHEON NORTHBORO MA
CONTRACT# : F08635-80-C-0272 CLOSED
APPROPRIATION : 3020 AMOUNT IN $ X 1000 : $ 625
MISSION : TACTICAL WARFARE
THRUST : TACTICAL SYSTEMS

PROJECT OBJECTIVE

TO ESTABLISH MANUFACTURING METHODS FOR MICROWAVE INTEGRATED CIRCUITS THAT WILL REDUCE COSTS, MATERIALS, PROCESSES, AND EQUIPMENT. REQUIREMENTS WERE EXAMINED IN DETAIL AND A DEMONSTRATION MODULE WAS PRODUCED.

TITLE : GALLIUM ARSENIDE MICROWAVE SUBSTRATES
CONTRACTOR : LASER DIODE LABORATORIES METUCHEN NJ
CONTRACT# : F33615-75-C-5006 CLOSED
APPROPRIATION : 3010 AMOUNT IN $ X 1000 : $ 245
MISSION : GENERIC
THRUST : ELECTRONICS

PROJECT OBJECTIVE

TO PROVIDE THE MANUFACTURING PROCESSES THAT WILL SUPPLY THE REQUIRED TYPE AND QUALITY OF GALLIUM ARSENIDE SUBSTRATES NEEDED FOR THE FABRICATION OF EFFICIENT, REPRODUCIBLE MICROWAVE DEVICES. IN ADDITION, A COMMERCIAL SOURCE FOR THESE SUBSTRATES WILL BE ESTABLISHED.

MICROWAVE - SOLID STATE

TITLE : GALLIUM ARSENIDE PRODUCTION
CONTRACTOR : RAYTHEON WALTHAM MA
CONTRACT# : F33615-74-C-5031 CLOSED
APPROPRIATION : 3010 AMOUNT IN $ X 1000 : $ 266
MISSION : GENERIC
THRUST : ELECTRONICS

PROJECT OBJECTIVE

TO PROVIDE THE MANUFACTURING PROCESSES FOR HIGH QUALITY GALLIUM ARSENIDE EPITAXIAL LAYERS REQUIRED FOR DEVICE FABRICATION AND TO ESTABLISH A COMMERCIAL SOURCE OF THESE EPITAXIAE LAYERS.

TITLE : MICROWAVE SIGNAL SYNTHESIZER
CONTRACTOR : HUGHES CULVER CITY CA
CONTRACT# : F33615-78-C-5140 CLOSED
APPROPRIATION : 3010 AMOUNT IN $ X 1000 : $ 330
MISSION : C.C.C.I.
THRUST : ELECTRONICS

PROJECT OBJECTIVE

TO ESTABLISH THE MANUFACTURABILITY OF A FREQUENCY SYNTHESIZER DESIGNED FOR USE IN FAST FREQUENCY-HOPPING DIGITAL COMMUNICATION TERMINALS SUCH AS JOINT TACTICAL INFORMATION DISTRIBUTION SYSTEM (JTIDS) OPERATING IN THE D-BAND REGION.

MICROWAVE - SOLID STATE

TITLE : MT FOR FERRITE PHASERS
CONTRACTOR : RAYTHEON WALTHAM MA
CONTRACT# : F33615-78-C-5038 CLOSED
APPROPRIATION : 3010 AMOUNT IN $ X 1000 : $ 564
MISSION : ELECTRONIC COMBAT/RECON.
THRUST : ELECTRONICS

PROJECT OBJECTIVE

TO ESTABLISH THE BASELINE CHARACTERISTICS AND MANUFACTURING TECHNOLOGY NECESSARY FOR THE HIGH-VOLUME, LOW-COST PRODUCTION OF FERRITE PHASE CONTROL MODULES (PCMS) FOR OUR IN AIRBORNE ELECTRONIC PHASED ARRAY ANTENNA SYSTEMS.

TITLE : MM FOR MICROWAVE LIMITER
CONTRACTOR : HUGHES LOS ANGELES CA
CONTRACT# : F33615-74-C-5102
APPROPRIATION : 3010 AMOUNT IN $ X 1000 : $ 413
MISSION : C.C.C.I.
THRUST : ELECTRONICS

PROJECT OBJECTIVE

TO ESTABLISH ECONOMICAL AND RELIABLE MANUFACTURING METHODS FOR THE PRODUCTION OF MICROWAVE LIMITERS FOR RADAR RECEIVER PROTECTION.

MICROWAVE - SOLID STATE

TITLE : MT FOR HIGH RELIABILITY OF PKG OF MICS
CONTRACTOR : TEXAS INSTRUMENTS DALLAS TX
CONTRACT# : F33615-82-C-5094 OPEN
APPROPRIATION : 3010 AMOUNT IN $ X 1000 : $ 1825
MISSION : C.C.C.I.
THRUST : ELECTRONICS

PROJECT OBJECTIVE

ESTABLISH THE MANUFACTURING TECHNOLOGY METHODS AND PROCESSES TO MINIMIZE THE LABOR INTENSIVE OPERATIONS AND OTHER COSTS IN HIGH PRODUCTION VOLUME MANUFACTURING OF HYBRID MICROWAVE INTEGRATED CIRCUIT (MIC). A SYSTEMATIC INTEGRATED COST EFFECTIVE APPROACH TO TESTING, TRIMMING/MATCHING, FABRICATION, AND ASSEMBLY WILL BE DEFINED, IMPLEMENTED, AND DEMONSTRATED THAT HAS THE POTENTIAL OF BEING AUTOMATED/SEMIAUTOMATED.

TITLE : MT FOR PRECISION EXTRUDED ALUMINUM WAVEGUIDES
CONTRACTOR : WESTINGHOUSE BALTIMORE MD
CONTRACT# : F33615-76-C-5424 CLOSED
APPROPRIATION : 3010 AMOUNT IN $ X 1000 : $ 269
MISSION : C.C.C.I.
THRUST : ELECTRONICS

PROJECT OBJECTIVE

TO ESTABLISH IMPROVED METHODS FOR ECONOMICAL AND RELIABLE MANUFACTURE OF COMPLEX THIN-WALLED EXTRUDED ALUMINUM ALLOY PRECISION PARTS FOR ANTENNA SYSTEMS.

MICROWAVE - SOLID STATE

TITLE : MT FOR SOLID STATE TRANSMITTER PRODUCTION PROG
CONTRACTOR : HUGHES CANOGA PARK CA
CONTRACT# : F08635-80-C-0275 CLOSED
APPROPRIATION : 3020 AMOUNT IN $ X 1000 : $ 1813
MISSION : TACTICAL WARFARE
THRUST : TACTICAL SYSTEMS

PROJECT OBJECTIVE

TO ESTABLISH MANUFACTURING METHODS TO REDUCE THE PRODUCTION COST OF THE ADVANCED MEDIUM RANGE AIR TO AIR MISSILE. THIS PROGRAM SPECIFICALLY ADDRESSES COST REDUCTION OF THE IMPATT DIODE TRANSMITTER.

TITLE : MT FOR STRESS COMPENSATED CRYSTAL RESONATORS
CONTRACTOR : UNITED STATES ARMY/RADC FT MONMOUTH/ROME-NY NJ
CONTRACT# : MIPR-81-00024 OPEN
APPROPRIATION : 3020 AMOUNT IN $ X 1000 : $ 1497
MISSION : TACTICAL WARFARE
THRUST : TACTICAL SYSTEMS

PROJECT OBJECTIVE

EXPAND THE CAPABILITIES OF THE PILOT PRODUCTION LINE BEING ESTABLISHED UNDER ARMY PROJECT NO. 79-ETDL-DLM-01 (PHASE III) FOR AT-CUT QUARTZ CRYSTAL RESONATORS TO PERMIT THE FABRICATION AND TESTING OF 5.115 MHZ FUNDAMENTAL MODE SC-CUT QUARTZ CRYSTAL RESONATORS.

MICROWAVE - SOLID STATE

TITLE : MT FOR MILLIMETER WAVE IMPATT DIODES
CONTRACTOR : HUGHES CA
CONTRACT# : F33615-84-C-5022 OPEN
APPROPRIATION : 3020 AMOUNT IN $ X 1000 : $ 1141
MISSION : C.C.C.I.
THRUST : SPACE SYSTEMS

PROJECT OBJECTIVE

THE OBJECTIVE IS TO ESTABLISH THE PRODUCIBILITY, PACKAGING, AND UNIFORMITY REQUIREMENTS FOR SILICON IMPATT DIODES IN THE FREQUENCY RANGES OF 60 AND 94 GHZ.

MICROWAVE - TWT'S

TITLE : MT FOR STANDARDIZED COAXIAL MAGNETRONS
CONTRACTOR : UNITED STATES NAVY SAN DIEGO CA
CONTRACT# : MIPR-81-00014 CLOSED
APPROPRIATION : 3080 AMOUNT IN $ X 1000 : $ 750
MISSION : C.C.C.I.
THRUST : ELECTRONICS

PROJECT OBJECTIVE

ESTABLISH & DEMONSTRATE THE PROCESSES FOR FABRICATION OF PARTS, SUB-ASSEMBLIES, THEIR MANUFACTURING TOLERANCE MARGINS, AND PERFORMANCE CHARACTERISTICS FOR THE AF BAND I COAXIAL MAGNETRON. THE PROCESSES AND TECHNIQUES ARE TO BE EVALUATED DURING TASKS 1-10 OF THE NAVY PHASE OF THIS PROGRAM. ONE OF THE THREE TRANSMITTERS (TPN-19, GPN-20, OR MPN-13) IS TO BE USED AS A DEMONSTRATION VEHICLE.

TITLE : MT FOR SPACE TWT & TWTA
CONTRACTOR : HUGHES TORRANCE CA
CONTRACT# : F04701-82-C-0079 CLOSED
APPROPRIATION : 3020 AMOUNT IN $ X 1000 : $ 2453
MISSION : C.C.C.I.
THRUST : SPACE SYSTEMS

PROJECT OBJECTIVE

TO COMPLIMENT AND SUPPORT THE SPACE DIVISION DSCS III FOLLOW-ON BUY AND/OR TWTA IMPROVEMENT PROGRAM BY ADDRESSING THE FOLLOWING ASPECTS OF TWT MANUFACTURING. IMPROVED MANUFACTURING PROCESSES AND ENHANCED CONTROLS, DOCUMENTATION AND QUALITY ASSURANCE TO INCREASE RELIABILITY OF DSCS III & SPACE TWTAS,AND PROVIDE BASIS FOR APPLICATION OF MT RESULTS TO THE DEVELOPMENT OF FUTURE SPACE TWTAS.

MICROWAVE - TWT'S

TITLE : MT FOR EH BAND TWT AMPLIFIER
CONTRACTOR : HUGHES TORRANCE CA
CONTRACT# : F33615-79-C-5149 CLOSED
APPROPRIATION : 3010 AMOUNT IN $ X 1000 : $ 499
MISSION : ELECTRONIC COMBAT/RECON.
THRUST : ELECTRONICS

PROJECT OBJECTIVE

MT FOR EH BAND TWT AMPLIFIER IS TO ESTABLISH THE MANUFACTURING TECHNOLOGY REQUIRED TO MAKE EH BAND TRAVELING WAVE TUBE AVAILABLE TO AF SYSTEMS AT A REASONABLE LIFE CYCLE COST.

TITLE : MT FOR IJ BAND TWT AMPLIFIER
CONTRACTOR : RAYTHEON WALTHAM MA
CONTRACT# : F33615-79-C-5148 CLOSED
APPROPRIATION : 3010 AMOUNT IN $ X 1000 : $ 1186
MISSION : ELECTRONIC COMBAT/RECON.
THRUST : ELECTRONICS

PROJECT OBJECTIVE

ESTABLISH THE MANUFACTURING TECHNOLOGY REQUIRED TO MAKE I/J BAND TWTS AVAILABLE TO AF SYSTEMS AT A REASONABLE LIFE CYCLE COST. TECHNIQUES TO INCREASE EFFICIENCY AND MARGIN OF TOLERANCE ARE THE PRIME TECHNICAL APPROACHES.

MICROWAVE - TWT'S

TITLE : MT FOR MINI TWTS FOR PHASED ARRAY
CONTRACTOR : VARIAN ASSOCIATES PALO ALTO CA
CONTRACT# : F33615-77-C-5103 CLOSED
APPROPRIATION : 3010 AMOUNT IN $ X 1000 : $ 119
MISSION : ELECTRONIC COMBAT/RECON.
THRUST : ELECTRONICS

PROJECT OBJECTIVE

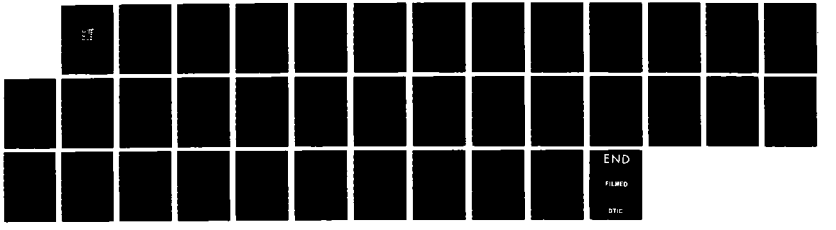
TO PROVIDE A MANUFACTURING CAPABILITY FOR LOW COST PRODUCTION OF MICROWAVE TUBES REQUIRED BY THE NAVY AN/SLQ 32 SYSTEM AND AF ADVANCED JAMMER.

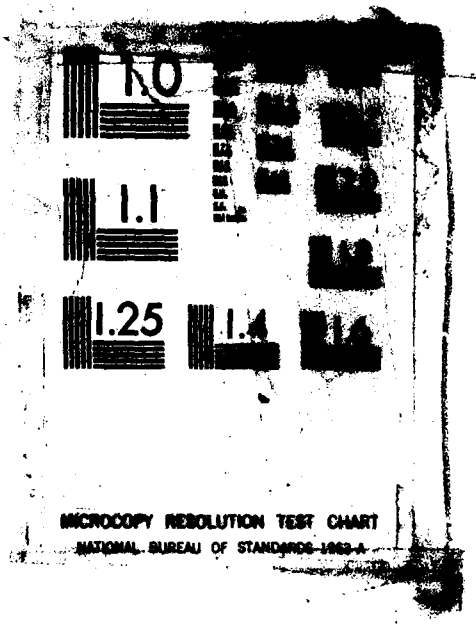
TITLE : KLYSTRON POWER AMPLIFIER
CONTRACTOR : GENERAL ELECTRIC CO SCHENECTADY NY
CONTRACT# : F33615-79-C-5145 CLOSED
APPROPRIATION : 3010 AMOUNT IN $ X 1000 : $ 774
MISSION : C.C.C.I.
THRUST : ELECTRONICS

PROJECT OBJECTIVE

TO IMPROVE MANUFACTURING METHODS TO ENHANCE PRODUCIBILITY OF KLYSTRONS BY REFINING THE CURRENT MANUFACTURING/DESIGN PROCEDURES AND VERIFYING MARGIN AND TOLERANCES SO THAT A HIGH YIELD AT TEST CAN BE ACHIEVED.

AD-A157 595 AIR FORCE MANUFACTURING TECHNOLOGY ELECTRONICS PROGRAM 2/2
FY72-FY85(U) UNIVERSAL TECHNOLOGY CORP DAYTON OHIO
R D HUTCHENS ET AL. APR 85 AFWAL-TR-85-4030
UNCLASSIFIED F33615-83-C-5077 F/G 9/2 NL

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MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

MICROWAVE - TWT'S

TITLE : MT FOR BEAM TESTER
CONTRACTOR : UNITED STATES NAVY WASHINGTON DC
CONTRACT# : MIPR-77-02444 CLOSED
APPROPRIATION : 3010 AMOUNT IN $ X 1000 : $ 100
MISSION : ELECTRONIC COMBAT/RECON.
THRUST : ELECTRONICS

PROJECT OBJECTIVE

TO ESTABLISH A TOOL FOR MANUFACTURING TWT'S THAT CAN BE USED TO CUT PRODUCT COSTS IN ASSEMBLY AND TEST.

TITLE : MM FOR MINIATURE TWT
CONTRACTOR : VARIAN ASSOCIATES PALO ALTO CA
CONTRACT# : F33615-73-C-5032 CLOSED
APPROPRIATION : 3010 AMOUNT IN $ X 1000 : $ 779
MISSION : ELECTRONIC COMBAT/RECON.
THRUST : ELECTRONICS

PROJECT OBJECTIVE

TO PROVIDE A MANUFACTURING CAPABILITY FOR THE LOW COST PRODUCTION OF MICROWAVE TUBES REQUIRED FOR THE B-1 ECM EQUIPMENT.

MICROWAVE - TWT'S

TITLE : DUAL MODE TRAVELING WAVE TUBE
CONTRACTOR : TELEDYNE INC PALO ALTO CA
CONTRACT# : F33615-75-C-5175 CLOSED
APPROPRIATION : 3010 AMOUNT IN $ X 1000 : $ 961
MISSION : ELECTRONIC COMBAT/RECON.
THRUST : ELECTRONICS

PROJECT OBJECTIVE

SIMPLIFY THE DESIGN, ESTABLISH MAXIMUM ELECTRICAL AND MECHANICAL TOLERANCES. DETERMINE THE MANUFACTURING TECHNIQUES AND PROCESSES THAT RESULT IN LOWEST COST. SIMPLIFY APPENDAGES EXTERNAL TO THE VACUUM ENVELOPE AND MAKE THEM ACCESSIBLE FOR REPAIR. ESTABLISH A PILOT PRODUCTION LINE & BUILD SAMPLE TUBES TO DEMONSTRATE ABOVE OBJECTIVES. PERFORM ENVIRONMENTAL TESTS TO SHOW THAT LIFE CYCLE COSTS & PURCHASE COST ARE REDUCED.

TITLE : I/J BAND AMPLIFIER
CONTRACTOR : TELEDYNE INC PALO ALTO CA
CONTRACT# : F33615-77-C-5068 CLOSED
APPROPRIATION : 3010 AMOUNT IN $ X 1000 : $ 349
MISSION : ELECTRONIC COMBAT/RECON.
THRUST : ELECTRONICS

PROJECT OBJECTIVE

SAMPLE TWT AMPLIFIERS WILL BE FABRICATED AND TESTED IN ORDER TO DEMONSTRATE THAT, A. THE DUAL MODE DESIGN IS PRODUCIBLE AT HIGH YIELD B. THE TWT/POWER SUPPLY/MODULATOR INTERFACES ARE NON-CRITICAL C. REQUIRED SYSTEM PERFORMANCE CHARACTERISTICS CAN BE ACHIEVED WITH A LIGHTWEIGHT LOW COST AND EFFICIENT TRANSMITTER MODULE D. THE DESIGN IS COMPATIBLE WITH CURRENT AND PLANNED AF AND NAVY ECM SYSTEMS.

MICROWAVE - TWT'S

TITLE : IMPROVED ELECTRON GUNS
CONTRACTOR : LEHRER-PEARSON INC PLEASANTON CA
CONTRACT# : F33615-83-C-5111 CLOSED
APPROPRIATION : 3005 AMOUNT IN $ X 1000 : $ 70
MISSION : ELECTRONIC COMBAT/RECON.
THRUST : ELECTRONICS

PROJECT OBJECTIVE

CONTROL ELECTRODE GEOMETRY & DEGREE OF MECHANICAL ALIGNMENT OF SELECTED ELECTRON GUN PARTS OF TRAVELING WAVE TUBES TO DETERMINE TOLERANCE MARGINS.
(SMALL BUSINESS INNOVATIVE RESEARCH PROGRAM)

TITLE : MT FOR ADVANCED DISPENSER CATHODES
CONTRACTOR : SEMICON CA
CONTRACT# : F33615-84-C-5012 OPEN
APPROPRIATION : 3095 AMOUNT IN $ X 1000 : $ 1127
MISSION : C.C.C.I.
THRUST : SPACE SYSTEMS

PROJECT OBJECTIVE

TO PROVIDE MANUFACTURING METHODS SUITABLE FOR HIGH PERFORMANCE TRAVELING WAVE TUBES EMPLOYED IN COMMUNICATION SYSTEMS ON SURVEILANCE SPACE SYSTEMS. THE TRAVELING WAVE TUBES USED IN THESE COMMUNICATIONS SYSTEMS MUST PROVIDE RELIABLE SERVICE UPWARDS TO TEN YEARS. A LONGER LIVED DISPENSER CATHODE WOULD PROVIDE THE NEEDED TUBE LIFE.

MICROWAVE - TWT'S

TITLE : MT FOR MILLIMETER TWT
CONTRACTOR : RAYTHEON WALTHAM MA
CONTRACT# : F33615-78-C-5150 OPEN
APPROPRIATION : 3080 AMOUNT IN $ X 1000 : $ 1454
MISSION : C.C.C.I.
THRUST : ELECTRONICS

PROJECT OBJECTIVE

TO ESTABLISH A BASELINE US MANUFACTURING SOURCE FOR HIGH POWER MILLIMETER WAVE TRAVELING WAVE TUBES (TWTS) AND METAL CAPILLARY THERMIONIC CATHODES. THE MANUFACTURING TECHNOLOGY PRESENTLY EXISTS AT SIEMENS AG MUNICH, GERMANY. THE TECHNOLOGY TO BE TRANSFERRED TO US INDUSTRY CONSISTS OF (1)THE COMPUTER MODELLING DESIGN AND (2)THE MACHINING TECHNIQUE AND TOLERANCE CONTROLS FOR ALL ASPECTS OF THE SIEMENS V684 TWT.

TITLE : TWT AMPLIFIER TECHNOLOGY FOR SPACE SYSTEMS
CONTRACTOR : UNITED STATES AIR FORCE LOS ANGELES CA
CONTRACT# : F04701-77-C-0048 CLOSED
APPROPRIATION : 3020 AMOUNT IN $ X 1000 : $ 199
MISSION : C.C.C.I.
THRUST : SPACE SYSTEMS

PROJECT OBJECTIVE

TO ESTABLISH MANUFACTURING METHODS FOR LOW COST HIGH RELIABILITY FABRICATION AND ACTIVATION OF OXIDE CATHODES FOR USE IN SPACE TRAVELING WAVE TUBES. MANUFACTURING PROCESSES AND CONTROLS SHALL BE CRITICALLY REVIEWED AND ANALYZED, LEADING TO DEFINITION OF AN AUTOMATED IMPLEMENTATION OF AN OPTIMIZED CATHODE ACTIVATION PROCESS.

PRINTED WIRING BOARDS

TITLE : MT FOR PWB ELECTRO DEPOSITION PROCESSES
CONTRACTOR : ROCKWELL INTERNATIONAL THOUSAND OAKS CA
CONTRACT# : F33615-81-C-5108 OPEN
APPROPRIATION : 3080 AMOUNT IN $ X 1000 : $ 467
MISSION : GENERIC
THRUST : ELECTRONICS

PROJECT OBJECTIVE

TO ESTABLISH AND OPTIMIZE ACID COPPER AND ELECTROLESS COPPER PWB PRODUCTION PLATING OPERATIONS BY CHARACTERIZATION OF THE PRODUCTION PWB PLATING SYSTEM. DEFINITION OF PLATING OPERATING CONDITIONS, ACTUAL PRODUCTION IMPLEMENTATION OF THE OPTIMIZED PROCESS CONTROL PROCEDURES, AND VERIFICATION/DEMONSTRATION OF COST IMPROVEMENTS.

TITLE : MT FOR PRINTED WIRING BOARD PROCESSES/CONTROL
CONTRACTOR : MARTIN MARIETTA ORLANDO FL
CONTRACT# : F33615-80-C-5122 CLOSED
APPROPRIATION : 3010 AMOUNT IN $ X 1000 : $ 397
MISSION : GENERIC
THRUST : ELECTRONICS

PROJECT OBJECTIVE

THE OBJECTIVE OF THIS PROGRAM IS TO IMPROVE PRINTED WIRING BOARD (PWB) PROCESS YIELDS AND REDUCE MANUFACTURING COSTS BY OPTIMIZING THE PWB DESIGN MANUFACTURING PRODUCIBILITY INTERFACE.

PRINTED WIRING BOARDS

TITLE : MT FOR PWB ELECTRO DEPOSITION PROCESS CONTROL
CONTRACTOR : ROCKWELL INTERNATIONAL CEDAR RAPIDS IO
CONTRACT# : F33615-79-C-5079 CLOSED
APPROPRIATION : 3010 AMOUNT IN $ X 1000 : $ 391
MISSION : GENERIC
THRUST : ELECTRONICS

PROJECT OBJECTIVE

TO ESTABLISH EFFECTIVE/EFFICIENT/DYNAMIC PROCESS CONTROLS FOR MONITORING AND CONTROLLING ELECTROPLATING PROCESSES USED IN PRINTED WIRING BOARD MFG OPERATIONS. EMPHASIS OF THE PROGRAM WILL BE DIRECTED TOWARD ON-LINE PRODUCTION IMPLEMENTATION OF CONTROL TECHNIQUES FOR PWB COPPER ELECTRO-DISPOSITION PROCESSES WITH A COMPREHENSIVE DOCUMENTATION OF TECHNOLOGI-CAL IMPACT ON PROCESS YIELDS, PRODUCT QUALITY, RELIABILITY, PROD. RATES.

TITLE : IMPROVED MANUFACTURING PROCESS FOR POLYIMIDE PRINTED CIRCUIT
CONTRACTOR : MCDONNELL DOUGLAS ST CHARLES MO
CONTRACT# : F33615-76-C-5045 CLOSED
APPROPRIATION : 3010 AMOUNT IN $ X 1000 : $ 305
MISSION : GENERIC
THRUST : ELECTRONICS

PROJECT OBJECTIVE

TO ESTABLISH IMPROVED MANUFACTURING TECHNIQUES FOR THE FABRICATION, ASSEMBLY, AND TEST OF LOW COST POLYIMIDE PRINTED CIRCUIT BOARDS.

PRINTED WIRING BOARDS

TITLE : MT FOR DIRECT PATTERN GENERATION OF PWB
CONTRACTOR : WESTINGHOUSE BALTIMORE MD
CONTRACT# : F33615-78-C-5151 CLOSED
APPROPRIATION : 3080 AMOUNT IN $ X 1000 : $ 237
MISSION : GENERIC
THRUST : ELECTRONICS

PROJECT OBJECTIVE

TO ESTABLISH MANUFACTURING TECHNIQUES AND PRODUCTION EQUIPMENT REQUIREMENTS FOR AUTOMATED PRINTED WIRING BOARD PHOTORESIST EXPOSURE. EMPHASIS OF THE PROGRAM SHALL BE ON ESTABLISHING A DYNAMIC IN-LINE LASER PATTERN GENERATOR CAPABLE OF OPERATING DIRECTLY FROM A COMPUTER BASED INPUT.

TITLE : MT FOR THICK FILM CERAMIC CIRCUIT CARDS
CONTRACTOR : HUGHES CANOGA PARK CA
CONTRACT# : F08635-80-C-0343 CLOSED
APPROPRIATION : 3020 AMOUNT IN $ X 1000 : $ 722
MISSION : TACTICAL WARFARE
THRUST : TACTICAL SYSTEMS

PROJECT OBJECTIVE

ESTABLISH A LOW COST, LARGE AREA, THICK FILM CERAMIC CIRCUIT BOARD MANUFACTURING PROCESS. THE PROCESS WAS TO RESULT IN A NON-NOBLE METAL MULTI-LAYER STRUCTURE OF OVER 200 SQUARE CENTIMETERS, THE TOP LAYER OF WHICH WAS SUITABLE FOR SOLDER ATTACHMENT OF LEADLESS CERAMIC CARRIERS.

PRINTED WIRING BOARDS

TITLE : MT FOR COPPER MULTI-LAYER CERAMIC CARDS
CONTRACTOR : RAYTHEON BEDFORD MA
CONTRACT# : F08635-80-C-0169 CLOSED
APPROPRIATION : 3020 AMOUNT IN $ X 1000 : $ 818
MISSION : TACTICAL WARFARE
THRUST : TACTICAL SYSTEMS

PROJECT OBJECTIVE

ESTABLISH RELIABLE AND LOW COST MANUFACTURING PROCESSES AND METHODS TO ATTACH HERMETIC CHIP CARRIERS ONTO LARGE, MODULE SIZE CERAMIC SUBSTRATES METALIZED WITH COPPER CONDUCTOR INKS AS A REPLACEMENT FOR GOLD.

PRINTED WIRE ASSEMBLIES

TITLE : AUTOMATED INSPECTION OF PWAS
CONTRACTOR : HUGHES LOS ANGELES CA
CONTRACT# : F33615-82-C-5006 CLOSED
APPROPRIATION : 3080 AMOUNT IN $ X 1000 : $ 717
MISSION : GENERIC
THRUST : ELECTRONICS

PROJECT OBJECTIVE

TO ESTABLISH DESIGN CRITERIA FOR A NONCONTACTING AUTOMATIC INFRARED TESTING AND INSPECTION SYSTEM FOR FAULT ISOLATION OF POWER RELATED PROBLEMS ON PRINTED CIRCUIT BOARDS AND WIRED ASSEMBLIES

TITLE : HIGH RELIABILITY PKG USING HCCS WITH COMPATIBLE PWBS
CONTRACTOR : TEXAS INSTRUMENTS DALLAS TX
CONTRACT# : F33615-82-C-5071 OPEN
APPROPRIATION : 3080 AMOUNT IN $ X 1000 : $ 3372
MISSION : GENERIC
THRUST : ELECTRONICS

PROJECT OBJECTIVE

TO ESTABLISH MANUFACTURING TECHNIQUES WHICH WILL PROVIDE A RELIABLE INTERCONNECTION TECHNOLOGY BETWEEN PRINTED WIRING BOARDS AND HERMETIC CHIP CARRIER PACKAGES.

PRINTED WIRE ASSEMBLIES

TITLE : MT FOR HIGH SPEED DIGITAL PROCESSING PKG
CONTRACTOR : WESTINGHOUSE BALTIMORE MD
CONTRACT# : F33615-80-C-5046 CLOSED
APPROPRIATION : 3010 AMOUNT IN $ X 1000 : $ 390
MISSION : TACTICAL WARFARE
THRUST : TACTICAL SYSTEMS

PROJECT OBJECTIVE

TO ESTABLISH AND DEMONSTRATE MANUFACTURING PROCESSES AND CONTROLS FOR DENSE PACKAGING OF HIGH SPEED DIGITAL PROCESSOR CIRCUITRY USED IN AIRBORNE RADAR SIGNAL PROCESSORS. ELECTRONICS MODULES WILL BE FABRICATED UTILIZING AVAILABLE EMITTER COUPLED LOGIC (ECL) CIRCUITRY TO DEMONSTRATE THE PACKAGING TECHNIQUES.

TITLE : MT FOR ELIM OF LOOSE METAL PART IN MICRO PKG
CONTRACTOR : HUGHES CULVER CITY CA
CONTRACT# : F33615-76-C-5273 CLOSED
APPROPRIATION : 3010 AMOUNT IN $ X 1000 : $ 450
MISSION : GENERIC
THRUST : ELECTRONICS

PROJECT OBJECTIVE

TO ESTABLISH THE MANUFACTURING PROCESSES AND TECHNIQUES REQUIRED TO ELIMINATE LOOSE METALLIC PARTICLES THAT CAN CAUSE ELECTRICAL SHORT FAILURES IN MICROELECTRONIC CIRCUITS.

PRINTED WIRE ASSEMBLIES

TITLE : MT FOR CONFORMAL COATING
CONTRACTOR : ROCKWELL INTERNATIONAL ANAHEIM CA
CONTRACT# : F33615-78-C-5138 CLOSED
APPROPRIATION : 3010 AMOUNT IN $ X 1000 : $ 237
MISSION : GENERIC
THRUST : ELECTRONICS

PROJECT OBJECTIVE

THE OBJECTIVE OF THIS PROGRAM IS TO ESTABLISH AND OPTIMIZE CONFORMAL COATING MANUFACTURING PROCESSES, TECHNIQUES, AND PROCESS CONTROLS FOR RELIABLY COATING AF PWB ELECTRONIC ASSEMBLIES. MAINTAINABILITY ASPECTS OF PWB COATINGS WILL BE EMPHASIZED IN THIS EFFORT. SPECIFIC GOALS WILL INCLUDE THE SIMPLIFICATION OF COATING REWORK/REPAIR TECHNIQUES AND ASSOCIATED REDUCTION OF MAINTAINABILITY COSTS.

TITLE : REPAIR OF CONFORMALLY COATED PRINTED WIRING BOARDS
CONTRACTOR : HUGHES CULVER CITY CA
CONTRACT# : F33615-78-C-5058 CLOSED
APPROPRIATION : 3010 AMOUNT IN $ X 1000 : $ 212
MISSION : GENERIC
THRUST : ELECTRONICS

PROJECT OBJECTIVE

TO IMPROVE TECHNIQUES AND ESTABLISH EFFECTIVE PROCESSING PROCEDURES FOR REPAIRING CONFORMALLY COATED PWB ELECTRONIC ASSEMBLIES CURRENTLY BEING USED IN AF SYSTEMS. EMPHASIS PLACED ON STANDARDIZATION OF TECHNIQUES, TOOLS, MATERIALS, ETC. TO ASSURE MAXIMUM EASE OF USE AND PROCESS COMMONALITY AS WELL AS PROVIDING IMPROVEMENTS IN RELIABILITY/MAINTAINABILITY OF THE REPAIRED PWB ELECTRONIC ASSEMBLY.

PRINTED WIRE ASSEMBLIES

TITLE : MT FOR HIGH REL WIRE BONDING IN HYBRID CIRCUITS
CONTRACTOR : BOEING SEATTLE WA
CONTRACT# : F33615-80-C-5010 CLOSED
APPROPRIATION : 3020 AMOUNT IN $ X 1000 : $ 513
MISSION : STRATEGIC OFFENSE
THRUST : STRATEGIC MISSILES

PROJECT OBJECTIVE

THE OBJECTIVE OF THIS EFFORT IS TO ESTABLISH LOW COST HYBRID CIRCUIT INTRACONNECTION MANUFACTURING PROCESSES. THESE PROCESSES PRODUCED RELIABLE ALUMINUM WIRE BONDS ON TO THICK GOLD FILMS ON MULTILAYER CERAMIC SUBSTRATES.

INTEGRATED CIRCUITS

TITLE : INTELL. MFG. SYSTEM FOR ASSY OF SURFACE MOUNT TECH
CONTRACTOR : PRACTICAL DESIGN LABS NASHUA NH
CONTRACT# : F33615-83-C-5112 CLOSED
APPROPRIATION : 3005 AMOUNT IN $ X 1000 : $ 48
MISSION : GENERIC
THRUST : ELECTRONICS

PROJECT OBJECTIVE

TO DEVELOP A TECHNICAL SPECIFICATION FOR AN INTELLIGENT MANUFACTURING SYSTEM (IMS) FOR SURFACE MOUNTING COMPONENTS ON PRINTED WIRING BOARD ASSEMBLIES (PWAS).
(SMALL BUSINESS INNOVATIVE RESEARCH PROGRAM)

TITLE : MT FOR HERMETIC CHIP CARRIER
CONTRACTOR : RCA CORP SOMERVILLE NJ
CONTRACT# : F33615-77-C-5158 CLOSED
APPROPRIATION : 3080 AMOUNT IN $ X 1000 : $ 1202
MISSION : GENERIC
THRUST : ELECTRONICS

PROJECT OBJECTIVE

THIS PROGRAM IS TO ESTABLISH THE MANUFACTURING PROCESSES AND TECHNIQUES REQUIRED FOR THE PRODUCTION OF MONOLITHIC DEVICES IN A FAMILY OF HERMETIC CHIP CARRIER PACKAGES. MONOLITHIC MEMORY DEVICE PACKAGES HAVE BEEN INCLUDED IN THE PROGRAM.

INTEGRATED CIRCUITS

TITLE : MT FOR AUTOMATED CONTROLS FOR CONTINUOUS EPITAXIAL PROCESS
CONTRACTOR : MOTOROLA INC. PHOENIX AZ
CONTRACT# : F33615-72-C-1242 CLOSED
APPROPRIATION : 3010 AMOUNT IN $ X 1000 : $ 348
MISSION : GENERIC
THRUST : ELECTRONICS

PROJECT OBJECTIVE

THE OBJECTIVE IS TO ESTABLISH ADVANCED EPITAXIAL PROCESSES FOR CONTINUOUS PROCESSING OF SPECIAL INTEGRATED CIRCUIT WAFERS WHICH WILL RESULT IN GREATER YIELDS AT LOWER COSTS AND, THUS, IMPROVE THE REPRODUCIBILITY AND AVAILABILITY OF MANY INTEGRATED CIRCUITS STRUCTURES.

TITLE : SURFACE INSPECTION TECHNIQUES FOR LSI PRODUCTION
CONTRACTOR : TEXAS INSTRUMENTS DALLAS TX
CONTRACT# : F33615-73-C-5047 CLOSED
APPROPRIATION : 3010 AMOUNT IN $ X 1000 : $ 414
MISSION : GENERIC
THRUST : ELECTRONICS

PROJECT OBJECTIVE

TO ESTABLISH RAPID MANUFACTURING PROCESS CONTROLS IN LARGE SCALE INTEGRATED (LSI) CIRCUIT MANUFACTURING FABRICATION RELATED TO PROCESS INDUCED DAMAGE, CONTAMINATION, AND GEOMETRIC VARIATIONS OR FLAWS.

INTEGRATED CIRCUITS

TITLE : CHARGE COUPLED DEVICE MEMORY ARRAYS
CONTRACTOR : FAIRCHILD MOUNTAIN VIEW CA
CONTRACT# : F33615-74-C-5088 CLOSED
APPROPRIATION : 3010 AMOUNT IN $ X 1000 : $ 469
MISSION : C.C.C.I.
THRUST : TACTICAL SYSTEMS

PROJECT OBJECTIVE

TO ESTABLISH MANUFACTURING PROCESSES, CONTROLS AND MATERIALS FOR ECONOMICAL VOLUME PRODUCTION OF LARGE CHARGE COUPLED DEVICE (CCD) DIGITAL MEMORY ARRAYS.

TITLE : PROJECTION MASKING SYSTEM
CONTRACTOR : PERKIN ELMER CORP NORWALK CT
CONTRACT# : F33615-71-C-1438 CLOSED
APPROPRIATION : 3010 AMOUNT IN $ X 1000 : $ 97
MISSION : GENERIC
THRUST : ELECTRONICS

PROJECT OBJECTIVE

TO FABRICATE A PROJECTION MASKING SYSTEM AND REGISTRATION SCHEME WHICH WILL REPLACE THE PRESENT CONTACT MASKING TECHNIQUES AND BE CAPABLE OF DEFINING SMALL LINE WIDTH PATTERNS WITH A HIGH DEGREE OF UNIFORMITY OVER A LARGE AREA.

INTEGRATED CIRCUITS

TITLE : RADIATION HARDENED CMOS/SOS MICROPROCESSORS
CONTRACTOR : RCA CORP SOMERVILLE NJ
CONTRACT# : F33615-78-C-5135 OPEN
APPROPRIATION : 3020 AMOUNT IN $ X 1000 : $ 1742
MISSION : C.C.C.I.
THRUST : SPACE SYSTEMS

PROJECT OBJECTIVE

ESTABLISH MANUFACTURING CAPABILITY FOR VOLUME PRODUCTION OF RADIATION HARDENED, HIGH RELIABILITY MICROPROCESSOR/MICROCOMPUTER INTEGRATED CIRCUITS.

TITLE : MOS-FET BIPOLAR INTEGRATED CIRCUITS
CONTRACTOR : FAIRCHILD MOUNTAIN VIEW CA
CONTRACT# : F33615-72-C-1522 CLOSED
APPROPRIATION : 3010 AMOUNT IN $ X 1000 : $ 168
MISSION : GENERIC
THRUST : ELECTRONICS

PROJECT OBJECTIVE

TO ESTABLISH MANUFACTURING PROCESSES FOR THE PRODUCTION OF COMPATIBLE MOS-FET/BIPOLAR DEVICES ON THE SAME WAFER AND PRODUCE TWO CIRCUITS USING THESE PARTS IN A MONOLITHIC STRUCTURE.

INTEGRATED CIRCUITS

TITLE : LOGIC ARRAYS FOR SATELLITES
CONTRACTOR : RCA CORP SOMERVILLE NJ
CONTRACT# : F33615-76-C-5374 CLOSED
APPROPRIATION : 3020 AMOUNT IN $ X 1000 : $ 165
MISSION : C.C.C.I.
THRUST : SPACE SYSTEMS

PROJECT OBJECTIVE

ESTABLISH MANUFACTURING CAPABILITY FOR VOLUME PRODUCTION OF RADIATION HARDENED CMOS CIRCUITS.

TITLE : MNOS MEMORY FOR SATELLITES
CONTRACTOR : WESTINGHOUSE BALTIMORE MD
CONTRACT# : F33615-77-C-5149 CLOSED
APPROPRIATION : 3020 AMOUNT IN $ X 1000 : $ 1037
MISSION : C.C.C.I.
THRUST : SPACE SYSTEMS

PROJECT OBJECTIVE

TO ESTABLISH A MANUFACTURING CAPABILITY FOR THE VOLUME PRODUCTION OF METAL-NITRIDE-OXIDE SEMICONDUCTOR (MNOS) MEMORY ARRAYS WHICH CAN OPERATE RELIABLY IN HIGH RADIATION ENVIRONMENT REQUIRED FOR SATELLITE SYSTEMS.

INTEGRATED CIRCUITS

TITLE : MT FOR HIGH SPEED PROCESSOR
CONTRACTOR : WESTINGHOUSE BALTIMORE MD
CONTRACT# : F33615-78-C-5060 CLOSED
APPROPRIATION : 3080 AMOUNT IN $ X 1000 : $ 1481
MISSION : C.C.C.I.
THRUST : TACTICAL SYSTEMS

PROJECT OBJECTIVE

TO ESTABLISH MANUFACTURING METHODS FOR ECONOMICAL PRODUCTION AND APPLICATION OF HIGH SPEED MICROCIRCUITS REQUIRED TO IMPLEMENT ADVANCED COMMUNICATIONS AND RADAR PROCESSORS.

TITLE : SILICON ON INSULATING SUBSTRATE DEVICES
CONTRACTOR : RCA CORP SOMERVILLE NJ
CONTRACT# : F33615-73-C-5043 CLOSED
APPROPRIATION : 3020 AMOUNT IN $ X 1000 : $ 604
MISSION : C.C.C.I.
THRUST : SPACE SYSTEMS

PROJECT OBJECTIVE

ESTABLISH AND DEMONSTRATE NEW MANUFACTURING METHODS AND TECHNIQUES APPLICABLE TO VOLUME PRODUCTION OF HIGH PERFORMANCE MOS ARRAYS USING SILICON ON INSULATING SUBSTRATE TEACHNOLOGY.

INTEGRATED CIRCUITS

TITLE : MT FOR LARGE SCALE IC PRODUCT TESTING
CONTRACTOR : QUESTRON CORP. EL SEGUNDO CA
CONTRACT# : F33615-78-C-5117 CLOSED
APPROPRIATION : 3020 AMOUNT IN $ X 1000 : $ 998
MISSION : C.C.C.I.
THRUST : SPACE SYSTEMS

PROJECT OBJECTIVE

TO ESTABLISH LOW-COST PRODUCTION TEST METHODS FOR THE FUNCTIONAL VERIFICATION AND VALIDATION OF LARGE-SCALE-INTEGRATED-CIRCUIT PRODUCTS. FUNCTIONAL TEST METHODS AND EQUIPMENT IMPLEMENTATION WILL BE DEMONSTRATED ON RADIATION HARDENED CMOS/SOS LSICS.

TITLE : OPERATIONAL AMPLIFIERS FOR MISSILE AND SATELLITES
CONTRACTOR : NORTHROP CORP. HAWTHORNE CA
CONTRACT# : F33615-78-C-5006 CLOSED
APPROPRIATION : 3020 AMOUNT IN $ X 1000 : $ 866
MISSION : STRATEGIC OFFENSE
THRUST : STRATEGIC MISSILES

PROJECT OBJECTIVE

ESTABLISH MANUFACTURING PROCESSES FOR THE PRODUCTION OF HIGHLY RELIABLE RADIATION HARDENED OPERATIONAL AMPLIFIERS FOR MISSILES AND SATELLITES.

INTEGRATED CIRCUITS

TITLE : MT FOR LOW COST CHIP CARRIER
CONTRACTOR : TEXAS INSTRUMENTS DALLAS TX
CONTRACT# : F33615-78-C-5147 CLOSED
APPROPRIATION : 3080 AMOUNT IN $ X 1000 : $ 840
MISSION : GENERIC
THRUST : ELECTRONICS

PROJECT OBJECTIVE

THE OBJECT OF THIS PROGRAM IS TO OPTIMIZE THE PRODUCTION PROCESSES AND TECHNIQUES REQUIRED FOR LOW COST CHIP CARRIER PACKAGES AND TO ESTABLISH THAT PACKAGE AS AN ACCEPTED STANDARD FOR FUTURE MILITARY AND COMMERCIAL SYSTEMS APPLICATIONS.

TITLE : RADIATION HARDENED MULTIPLE IC PACKAGE
CONTRACTOR : FAIRCHILD MOUNTAIN VIEW CA
CONTRACT# : F33615-72-C-1125 CLOSED
APPROPRIATION : 3020 AMOUNT IN $ X 1000 : $ 246
MISSION : C.C.C.I.
THRUST : SPACE SYSTEMS

PROJECT OBJECTIVE

ESTABLISH MANUFACTURING PROCESSES AND TECHNIQUES TO ACHIEVE AN OPTIMIZED IC METALLIZATION SYSTEM ON EXISTING RADIATION-HARDENED CIRCUITS. THIS IC CHIP METALLIZATION SYSTEM WILL INCORPORATE THE ALUMINUM ANODIZATION PROCESS. PROCESS WILL BE APPLIED TO COMPLEX RADIATION HARDENED TTL MEDIUM SCALE INTEGRATED CIRCUITS. ESTABLISH PROCESSES TO INTERCONNECT THESE IC CHIPS IN HERMETICALLY-SEALED MULTIPLE CHIP CERAMIC PACKAGE.

INTEGRATED CIRCUITS

TITLE : MT FOR MICROCOMPUTER FUZE
CONTRACTOR : RCA CORP SOMERVILLE NJ
CONTRACT# : F33615-81-C-5144 OPEN
APPROPRIATION : 3080 AMOUNT IN $ X 1000 : $ 795
MISSION : TACTICAL WARFARE
THRUST : TACTICAL SYSTEMS

PROJECT OBJECTIVE

TO ESTABLISH A MANUFACTURING CAPABILITY FOR THE VOLUME PRODUCTION OF SINGLE CHIP MICROCOMPUTERS WHICH CAN OPERATE RELIABLY THROUGH THE MILITARY ENVIRONMENT EXPERIENCED IN IMPACT/DELAY FUZES FOR GENERAL PURPOSE BOMBS AND TACTICAL MUNITIONS.

TITLE : MT FOR SUBSTRATE ASSY W/HERMETIC CHIP CARRIERS
CONTRACTOR : TRACOR, INC. AUSTIN TX
CONTRACT# : F33615-80-C-5053 CLOSED
APPROPRIATION : 3080 AMOUNT IN $ X 1000 : $ 309
MISSION : GENERIC
THRUST : ELECTRONICS

PROJECT OBJECTIVE

TO ESTABLISH RELIABLE/LOW COST MANUFACTURING METHODS FOR THE PRODUCTION ASSEMBLY OF LEADLESS HERMETIC CHIP CARRIER PACKAGES DIRECTLY ONTO A SUITABLE PACKAGING AND INTERCONNECT STRUCTURE, THIS PACKAGING AND INTER CONNECT STRUCTURE SHALL BE MULTILAYER CERAMIC, PRINTED WIRING BOARD, OR OTHER COMPATIBLE SUBSTRATE TECHNOLOGY.

INTEGRATED CIRCUITS

TITLE : MT FOR RADIATION HARDENED A/D CONVERTER CHARACTERIZATION
CONTRACTOR : TRW INC. REDONDO BEACH CA
CONTRACT# : F33615-78-C-5145 CLOSED
APPROPRIATION : 3020 AMOUNT IN $ X 1000 : $ 460
MISSION : C.C.C.I.
THRUST : SPACE SYSTEMS

PROJECT OBJECTIVE

THE OBJECTIVE IS TO FABRICATE AND FULLY CHARACTERIZE MONOLITHIC A TO D CONVERTERS USING THE PROCESSES ESTABLISHED ON CONTRACT F33615-75-C-5135. THE PRIMARY EMPHASIS WILL BE ON RELIABILITY AND RADIATION PERFORMANCE.

TITLE : ADVANCED BUBBLE DOMAIN MATERIALS
CONTRACTOR : ROCKWELL INTERNATIONAL ANAHEIM CA
CONTRACT# : F33615-75-C-5010 CLOSED
APPROPRIATION : 3020 AMOUNT IN $ X 1000 : $ 265
MISSION : C.C.C.I.
THRUST : SPACE SYSTEMS

PROJECT OBJECTIVE

TO EXTEND THE MANUFACTURING PROCESSES EVOLVED UNDER F33615-73-C-1299 FOR THE PRODUCTION OF HIGH QUALITY GARNET THIN MAGNETIC FILMS FOR USE IN BUBBLE MASS MEMORIES.

INTEGRATED CIRCUITS

TITLE : MT FOR MICROPROCESSOR SUPPORT CIRCUITS
CONTRACTOR : ROCKWELL INTERNATIONAL ANAHEIM CA
CONTRACT# : F33615-80-C-5127 OPEN
APPROPRIATION : 3080 AMOUNT IN $ X 1000 : $ 1667
MISSION : C.C.C.I.
THRUST : SPACE SYSTEMS

PROJECT OBJECTIVE

TO ESTABLISH MANUFACTURING PROCESSES AND CONTROL NECESSARY FOR HIGH YIELD PRODUCTION OF SPECIALIZED SILICON GATE CMOS/SOS (COMPLEMENTARY METAL-OXIDE-SEMICONDUCTOR INTEGRATED CIRCUITS/SILICON ON SAPPHIRE SUBSTRATES) MICROPROCESSOR SUPPORT CIRCUITS THAT ARE CAPABLE OF MEETING THE RELIABILITY AND RADIATION DOSE REQUIREMENTS FOR MILITARY APPLICATION

TITLE : RADIATION HARDENED INTEGRATED CIRCUITS
CONTRACTOR : FAIRCHILD MOUNTAIN VIEW CA
CONTRACT# : F33615-72-C-1200 CLOSED
APPROPRIATION : 3020 AMOUNT IN $ X 1000 : $ 391
MISSION : C.C.C.I.
THRUST : SPACE SYSTEMS

PROJECT OBJECTIVE

THE PURPOSE OF THIS PROJECT IS TO ESTABLISH AND TO DEMONSTRATE NEW MANUFACTURING METHODS AND TECHNIQUES APPLICABLE TO THE PRODUCTION OF RADIATION HARDENED BIPOLAR INTEGRATED CIRCUITS WITH MSI/LSI COMPLEXITY LEVELS AND TO DEMONSTRATE THE COMPATIBILITY OF THE NEW PROCESSES AND TECHNIQUES WHEN COMBINED WITH EXISTING PROCESSES IN A PILOT PRODUCTION FACILITY

INTEGRATION

TITLE : MT FOR SM-ALC ELECTRONIC REPAIR CENTER
CONTRACTOR : WESTINGHOUSE BALTIMORE MD
CONTRACT# : F33615-83-C-5009 OPEN
APPROPRIATION : 3080 AMOUNT IN $ X 1000 : $ 619
MISSION : GENERIC
THRUST : ELECTRONICS

PROJECT OBJECTIVE

TO ESTABLISH INTEGRATED, EFFICIENT, MODERNIZED ELECTRONIC REPAIR CAPABILITIES AT WORK CENTER LEVELS TAILORED SPECIFICALLY TO THE SACRAMENTO AIR LOGISTICS CENTER COMMUNICATIONS-ELECTRONICS DIVISION.

INTEGRATION

TITLE : MT FOR ELECTRONIC CAD/CAM
CONTRACTOR : UNITED STATES ARMY RED STONE ARSENAL AL
CONTRACT# : MIPR-81-00010 CLOSED
APPROPRIATION : 3080 AMOUNT IN $ X 1000 : $ 1000
MISSION : GENERIC
THRUST : COMPUTER INTEGRATED MFG.

PROJECT OBJECTIVE

THIS PROGRAM IS INTENDED TO ADDRESS RELIABLE LOW COST ELECTRONIC SUBSYSTEM COMPONENTS MANUFACTURING THROUGH APPLICATION OF THE AF CAD/CAM ARCHITECTURE FOR MANUFACTURING. THIS PROGRAM WILL INVOLVE THE TOTAL ELECTRONICS INDUSTRY WITH HEAVY INVOLVEMENT OF THE MILITARY SYSTEM HOUSES AND WILL IDENTIFY THE AREAS OF OPPORTUNITY IN ELECTRONIC TECHNOLOGIES THAT OFFER GREATEST PROSPECT OF ECONOMIC PAYOFF FOR ELEC.& COMPUTER TECH

TITLE : MT FOR IMPROVED MFG PROCESSES/MTLS FOR CHASSIS
CONTRACTOR : WESTINGHOUSE BALTIMORE MD
CONTRACT# : F33615-80-C-5159 CLOSED
APPROPRIATION : 3080 AMOUNT IN $ X 1000 : $ 739
MISSION : GENERIC
THRUST : ELECTRONICS

PROJECT OBJECTIVE

TO ESTABLISH LOW COST/RELIABLE MANUFACTURING METHODS AND MATERIALS FOR THE FABRICATION OF GROUND BASED ELECTRONIC CHASSIS.

HARNESS AND CABLE

TITLE : MT FOR FIBER OPTIC EMITTERS
CONTRACTOR : NEW PROJECT ZZ
CONTRACT# : MTP 30092 NEW
APPROPRIATION : 3600 AMOUNT IN $ X 1000 : $ 700
MISSION : TACTICAL WARFARE
THRUST : ELECTRONICS

PROJECT OBJECTIVE

TO ESTABLISH AND OPTIMIZE THE MANUFACTURING PROCESSES AND TECHNIQUES REQUIRED TO PRODUCE HERMETICALLY SEALED LIGHT EMITTING DIODE (LED) MODULES FOR USE IN MILITARY FIBER OPTICS APPLICATIONS. IT IS DESIRED THAT THESE MODULES BE AVAILABLE IN QUANTITY BY LATE CY1985 FOR INCORPORATION INTO THE TACTICAL AIR CONTROL SYSTEM.

TITLE : MT FOR COMPUTERIZED WIRE KIT PREP
CONTRACTOR : GENERAL DYNAMICS FORT WORTH TX
CONTRACT# : F33615-79-C-5056 CLOSED
APPROPRIATION : 3010 AMOUNT IN $ X 1000 : $ 762
MISSION : TACTICAL WARFARE
THRUST : ELECTRONICS

PROJECT OBJECTIVE

TO PRODUCE A PROTOTYPE COMPUTER CONTROLLED AUTOMATED WIRE PREPARATION SYSTEM FOR USE IN REDUCING THE COST OF F16 AIRCRAFT ELECTRICAL TRUNK HARNESS SUBASSEMBLIES.

INTEGRATED CIRCUITS

TITLE : MT FOR CMOS/SOS ROM MEMORIES
CONTRACTOR : ROCKWELL INTERNATIONAL ANAHEIM CA
CONTRACT# : F33615-82-C-5110 OPEN
APPROPRIATION : 3080 AMOUNT IN $ X 1000 : $ 1205
MISSION : C.C.C.I.
THRUST : ELECTRONICS

PROJECT OBJECTIVE

ESTABLISH A MANUFACTURING CAPABILITY FOR THE VOLUME PRODUCTION OF SPECIALIZED SILICON GATE CMOS ROM CIRCUITS THAT ARE CAPABLE OF MEETING THE RELIABILITY AND MEDIUM RADIATION ENVIRONMENT FOR MILITARY SYSTEMS.

TITLE : MT FOR CMOS/SOS ROM MEMORIES
CONTRACTOR : TRW INC. REDONDO BEACH CA
CONTRACT# : F33615-82-C-5111 OPEN
APPROPRIATION : 3080 AMOUNT IN $ X 1000 : $ 985
MISSION : C.C.C.I.
THRUST : SPACE SYSTEMS

PROJECT OBJECTIVE

ESTABLISH A MANUFACTURING CAPABILITY FOR THE VOLUME PRODUCTION OF SPECIALIZED SILICON GATE CMOS ROM CIRCUITS THAT ARE CAPABLE OF MEETING THE RELIABILITY AND MEDIUM RADIATION ENVIRONMENT FOR MILITARY SYSTEMS.

INTEGRATED CIRCUITS

TITLE : SURFACE INSPECTION TECHNIQUES FOR LSI CIRCUITS
CONTRACTOR : CANADIAN COMMERCIAL CORP. OTTOWA,ONT, CANADA CD
CONTRACT# : F33615-78-C-5175 CLOSED
APPROPRIATION : 3080 AMOUNT IN $ X 1000 : $ 201
MISSION : GENERIC
THRUST : ELECTRONICS

PROJECT OBJECTIVE

TO ESTABLISH RAPID MANUFACTURING SURFACE INSPECTION OF LARGE SCALE INTEGRATED (LSI) CIRCUITS OPERATING UNDER DYNAMIC CONDITIONS USING A SCANNING ELECTRON MICROSCOPE IN THE VOLTAGE CONTRAST CONDITION AND STROBOSCOPIC MODE.

TITLE : MT FOR NONVOLATILE MEMORY
CONTRACTOR : RCA CORP SOMERVILLE NJ
CONTRACT# : F33615-83-C-5017 OPEN
APPROPRIATION : 3080 AMOUNT IN $ X 1000 : $ 431
MISSION : C.C.C.I.
THRUST : ELECTRONICS

PROJECT OBJECTIVE

TO ESTABLISH A MANUFACTURING CAPABILITY FOR METAL NITRIDE OXIDE SEMICONDUCTOR (MNOS) MEMORY DEVICES AT AN INTEGRATED CIRCUIT (IC) MANUFACTURER WHICH WILL FABRICATE THESE NON VOLATILE MEMORY DEVICES FOR USE IN A BROAD RANGE OF MILITARY SYSTEMS. PROCESSES WILL BE UTILIZED TO INCREASE STORAGE CAPACITY, REDUCE POWER, ACHIEVE RELIABLE OPERATION AND NUCLEAR HARDNESS.

INTEGRATED CIRCUITS

TITLE : MT FOR HERMETIC CHIP CARRIER
CONTRACTOR : HUGHES NEWPORT BEACH CA
CONTRACT# : F33615-77-C-5283 CLOSED
APPROPRIATION : 3080 AMOUNT IN $ X 1000 : $ 610
MISSION : GENERIC
THRUST : ELECTRONICS

PROJECT OBJECTIVE

THIS PROGRAM IS TO ESTABLISH THE MANUFACTURING PROCESSES AND TECHNIQUES REQUIRED FOR THE PRODUCTION OF MONOLITHIC DEVICES IN A FAMILY OF HERMETIC CHIP CARRIER PACKAGES.

POWER - SOLAR CELLS

TITLE : MT FOR GALLIUM ARSENIDE (GAAS) SOLAR CELLS
CONTRACTOR : APPLIED SOLAR ENERGY CORP. CITY OF INDUSTRY CA
CONTRACT# : F33615-81-C-5150 OPEN
APPROPRIATION : 3020 AMOUNT IN $ X 1000 : $ 3514
MISSION : C.C.C.I.
THRUST : SPACE SYSTEMS

PROJECT OBJECTIVE

TO ESTABLISH AND OPTIMIZE RELIABLE, LOW COST MANUFACTURING METHODS FOR THE PRODUCTION OF SPACE QUALIFIED GALLIUM ARSENIDE SOLAR CELLS. 1) A 50 PERCENT YIELD OF SPACE QUALIFIED GALLIUM ARSENIDE SOLAR CELLS 2) A PRODUCTION RATE 1000 CELL PER WEEK 3) A COST PER QUALIFIED CELL(2 cm x 2 cm EQUIVALENT) OF LESS THAN $40.00.

POWER - BATTERIES

TITLE : MT FOR THERMAL BATTERY PRODUCTION
CONTRACTOR : EAGLE PITCHER JOPLIN MO
CONTRACT# : F33615-84-C-5064 OPEN
APPROPRIATION : 3095 AMOUNT IN $ X 1000 : $ 1242
MISSION : TACTICAL WARFARE
THRUST : TACTICAL SYSTEMS

PROJECT OBJECTIVE

A 20 PERCENT COST REDUCTION FOR HIGH ENERGY DENSITY THERMAL BATTERIES BY ESTABLISHING MATERIALS AND MANUFACTURING PROCESSES. THE BATTERIES MUST BE CAPABLE OF SUPPLYING PEAK POWER FOR 80 SECONDS IN EXTREME TEMPERATURE ENVIRONMENTS, AND HAVE THE SHORT ACTIVATION TIME REQUIRED FOR MISSILE APPLICATIONS.

TITLE : LITHIUM BATTERIES FOR LIFE SUPPORT APPLICATIONS
CONTRACTOR : HONEYWELL INC. HORSHAM PA
CONTRACT# : F33615-76-C-5261 CLOSED
APPROPRIATION : 3080 AMOUNT IN $ X 1000 : $ 390
MISSION : GENERIC
THRUST : ELECTRONICS

PROJECT OBJECTIVE

TO ESTABLISH THE AUTOMATED PRODUCTION CAPABILITY REQUIRED TO PRODUCE A FAMILY OF STANDARD SIZED NON-RESERVE LITHIUM ANODE-ORGANIC ELECTROLYTE CELLS. IN MEETING THE REQUIREMENTS OF THE EXPECTED AF LIFE SUPPORT MISSIONS, THE LITHIUM ANODE CELLS MUST POSSESS THE FOLLOWING CHARACTERISTICS - HIGH INTEGRITY, HERMETICALLY SEALED, HIGH ENERGY, HIGH RELIABILITY AND SAFETY.

POWER - BATTERIES

TITLE : MT FOR LITHIUM BORON (LIB) ALLOYS
CONTRACTOR : UNITED STATES NAVY SILVER SPRINGS MD
CONTRACT# : MIPR -80-00008 OPEN
APPROPRIATION : 3080 AMOUNT IN $ X 1000 : $ 130
MISSION : TACTICAL WARFARE
THRUST : TACTICAL SYSTEMS

PROJECT OBJECTIVE

TO ESTABLISH MATERIALS AND MANUFACTURING PROCESSES FOR THE PRODUCTION OF LIB ANODE MATERIAL FOR USE IN CURRENT AND ADVANCED THERMAL BATTERY SYSTEMS. TO TEST THE SCALED-UP PRODUCTION MATERIAL TO INSURE THE LABORATORY FEASIBILITY DATA IS ACCURATE AND CAN BE REALIZED ON A PRODUCTION BASIS.

TITLE : MT FOR NICKEL-HYDROGEN BATTERY CELLS
CONTRACTOR : YARDNEY ELECTRIC CORP. PAWCATUCK CT
CONTRACT# : F33615-80-C-5036 OPEN
APPROPRIATION : 3020 AMOUNT IN $ X 1000 : $ 1061
MISSION : C.C.C.I.
THRUST : SPACE SYSTEMS

PROJECT OBJECTIVE

ESTABLISH MATERIALS AND MANUFACTURING METHODS FOR 50 AMP-HOUR NI/H2 BATTERIES WITH USABLE ENERGY DENSITY FROM 9-16 WATT-HOURS/POUND DEPENDING UPON FREQUENCY AND DEPTH OF DISCHARGE, AT A MAXIMUM COST OF $2.5K PER CELL.

POWER - BATTERIES

TITLE : MT FOR NICKEL-CADMIUM BATTERIES
CONTRACTOR : EAGLE PITCHER JOPLIN MO
CONTRACT# : F33615-76-C-5407 CLOSED
APPROPRIATION : 3010 AMOUNT IN $ X 1000 : $ 983
MISSION : TACTICAL WARFARE
THRUST : TACTICAL SYSTEMS

PROJECT OBJECTIVE

TO ESTABLISH LOW COST MANUFACTURING TECHNOLOGY AND A COMMERCIAL SOURCE FOR AEROSPACE CELLS USING NEW ELECTROCHEMICAL IMPREGNATION TECHNIQUES.

POWER - MAGNETS

TITLE : TEMPERATURE COMPENSATED MAGNETS
CONTRACTOR : CRUCIBLE STEEL CORP PITTSBURGH PA
CONTRACT# : F33615-78-C-5013 CLOSED
APPROPRIATION : 3010 AMOUNT IN $ X 1000 : $ 834
MISSION : ELECTRONIC COMBAT/RECON.
THRUST : ELECTRONICS

PROJECT OBJECTIVE

TO ESTABLISH MANUFACTURING METHODS FOR THE PRODUCTION OF INTRINSICALLY TEMPERATURE COMPENSATED, HIGHLY STABLE RARE EARTH COBALT MAGNETS FOR TWTS AND INERTIAL DEVICES.

TITLE : DEVICE APPLICATIONS FOR LOW COST RARE EARTH COBALT MAGNETS
CONTRACTOR : RAYTHEON WALTHAM MA
CONTRACT# : F33615-73-C-5059
APPROPRIATION : 3010 AMOUNT IN $ X 1000 : $ 171
MISSION : TACTICAL WARFARE
THRUST : TACTICAL SYSTEMS

PROJECT OBJECTIVE

TO DEMONSTRATE THE APPLICATIONS OF LOW COST RARE EARTH COBALT MAGNETS IN JET FUEL STARTER AND ACTUATOR PUMP MOTOR.

POWER SUPPLIES

TITLE : MT FOR IMPROVED HIGH VOLTAGE PWR SUPPLY PACKAGING
CONTRACTOR : BOEING SEATTLE WA
CONTRACT# : F33615-80-C-5171 CLOSED
APPROPRIATION : 3080 AMOUNT IN $ X 1000 : $ 871
MISSION : GENERIC
THRUST : ELECTRONICS

PROJECT OBJECTIVE

TO ESTABLISH AND OPTIMIZE HIGH VOLTAGE ENCAPSULATION MANUFACTURING TECHNIQUES AND TO INTEGRATE THESE WITH IMPROVED HIGH VOLTAGE QUALIFICATION/TESTING STANDARDS TO REDUCE THE MANUFACTURING COSTS AND LIFE CYCLE COSTS OF AIR FORCE HIGH VOLTAGE POWER SUPPLY ELECTRONICS.

TITLE : SPACE HIGH VOLTAGE POWER SUPPLIES
CONTRACTOR : WESTINGHOUSE BALTIMORE MD
CONTRACT# : F33615-77-C-5017 CLOSED
APPROPRIATION : 3020 AMOUNT IN $ X 1000 : $ 239
MISSION : C.C.C.I.
THRUST : SPACE SYSTEMS

PROJECT OBJECTIVE

OPTIMIZE THE MANUFACTURING PROCESSES AND TECHNIQUES REQUIRED FOR ENCAPSULATING HIGH VOLTAGE POWER SUPPLIES FOR SPACE APPLICATIONS.

POWER SUPPLIES

TITLE : MT FOR FINE FILAMENT SUPERCONDUCTIVE WIRE
CONTRACTOR : INTERMAGNETICS GENERAL CORP GUILDERLAND NY
CONTRACT# : F33615-75-C-5104 OPEN
APPROPRIATION : 3010 AMOUNT IN $ X 1000 : $ 935
MISSION : GENERIC
THRUST : ELECTRONICS

PROJECT OBJECTIVE

TO ESTABLISH LOW COST MANUFACTURING TECHNIQUES FOR THE PRODUCTION OF MULTIFILAMENT NB SUB 3 SN SUPERCONDUCTORS FOR AIRCRAFT HIGH POWER ELECTRICAL GENERATORS.

TITLE : AIRBORNE HIGH VOLTAGE POWER SUPPLIES
CONTRACTOR : BOEING SEATTLE WA
CONTRACT# : F33615-77-C-5015 CLOSED
APPROPRIATION : 3010 AMOUNT IN $ X 1000 : $ 330
MISSION : GENERIC
THRUST : ELECTRONICS

PROJECT OBJECTIVE

OPTIMIZE THE MANUFACTURING PROCESSES AND TECHNIQUES REQUIRED FOR ENCAPSULATING HIGH VOLTAGE POWER SUPPLIES FOR AIRBORNE APPLICATIONS.

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